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Comparison of vodnoy near red-green test to other selected near tests

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Comparison of vodnoy near red-green test to other selected near tests

Abstract

Comparison of vodnoy near red-green test to other selected near tests

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Harold M. Haynes

Subject Categories

Optometry

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COMPARISION OF VODNOY NEAR RED-GREEN TEST TO OTHER SELECTED NEAR TESTS

K433

OPTOMETRY THESIS

MAY 9, 1977

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ADVISED BY

HAROLD M. HAYNES, O.D.

GRADE _____

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We wish to specifically thank Dr. Harold Haynes, our advisor, for his many hours of dedicated help and support, also Dr. Joy Hirsch for her statistical assistance in the analysis of our data.

Finally, we would like to thank all those unnamed people, both subjects and supporters, that made this thesis possible.

Table of Contents

List of Tables, Graphs, and Histograms

PROBLEM

This thesis was designed to determine the relationship between the Vodnoy Red-Green test at sixteen inches, the midrange sixteen inch binocular cross cylinder test and a midrange high-low neutral dynamic retinoscopy (neutral from against motion-neutral from with motion) finding also taken at sixteen inches. In effect, the study was designed to compare the motor response lag of accommodation (MRLa) at sixteen inches under these three testing conditions. Clinically we wanted to know the extent to which the Vodnoy Red-Green test could be substituted for a midrange binocular cross cylinder or a midrange high-low retinoscopy finding.

To answer the general questions formulated above, the experiment was designed to study interclinician reliability, sequential test on retest reliability on a group of subjects by the same examiner and the correlation among the several tests. Through factoring out the distance refraction for each subject, measuring interclinican reliability and test on retest reliability for the same examiner and subject, the correlation between the findings would indicate the degree to which accommodate behavior is similar and/or dissimilar between the several tests.

Physiologically, it is important to know whether the three tests measure the same level of accommodative activity or whether the target, testing time and/or other test variables determine the accommodative response to the test.

The specific problems dealt with in this thesis are as follows:

1) Optical characteristics of the Vodnoy Red-Green Slide

2) Interclinician reliability of the distance "P" value

3) Red-Green Reliability

   a) Interclinician (N = 5)

   b) Sequential Finding Reliability (N = 20)

4) Comparison of Red-Green to the Cross Cylinder Test (14B) at 16"

   a) Distribution of RG - "P"

   b) Distribution of RG -14B

   c) Correlation of RG to 14B

5) Comparison of Red-Green to Midrange High Neutral - Low Neutral retinoscopy at 16"

   a) Distribution of Midrange HN - LN retinoscopy to "P"

   b) Distribution of RG - Midrange HN - LN retinoscopy

   c) Correlation of RG to Midrange HN - LN retinoscopy

6) Analysis for Red-Green variations as a function of successive measurement

7) Correlation of Midrange High-Low Neutral retinoscopy to 14B

LITERATURE RESEARCH

The refractive index of each of the media of the eye varies with λ, therefor the position of the image is affected. If the eye is adjusted to one specific wave length, it is not adjusted for any other wave lengths and the images produced by the other wave lengths will reach maximum optical definition either in front of or behind the retina. This phenomena of differential refraction as a function of wave length is know as chromatic aberration.

Le Grand[1] calculated the dioptric equivalent of the chromatic interval to be 1.50D. Millodot and Sivak[2] found it to be 1.60D.

Emsley[3] gives precedent to Clifford - Brown for the design of the bichrome test in 1927. The basic assumption is made that the eye is focused for the wavelength that gives maximum sensitivity under photopic conditions, 555 nm. Most bichrome tests manufactured in North America have a reversal point at 589 nm.

Peck[4] in 1933 stated that the average patient accepts the smallest yellow blur circle as being the chromatic position of best acuity. Borish[5] claims that the eye maintains imagery at this 555 nm focus through space. Pratt[10] and Haynes[11] collecting independent data show the American Optical Red-Green at twenty feet averages the same as #7A, #4, with a mean difference of 0.06D and a standard deviation of 0.19D.

Another hypothesis is put forth by Sivak.[6] He claims that the eye is focused for red at far and makes use of the chromatic interval before

accommodating. Thus the eye uses the chromatic interval to minimize accommodation. A study by Davies[7] substantiates Sivak's claim.

Ivanhoff[8] and Sivak[9], in independent studies, both showed that with a -0.50D stimulus to accommodation the eye is maximumly focused for 650 nm while with a -2.50D stimulus to accommodation the eye is maximally focused for the 500 nm wavelength. Maximum focus for the green wavelength at a 2.50D accommodative stimulus level may allow for a larger discrepancy between accommodative stimulus and accommodative response in a bichrome test than would be found in a similar achromatic test. This greater lag would become manifest as a bias toward plus in the bichrome test.

INSTRUMENTATION USED

FOR

NEAR RED-GREEN TESTING

The apparatus for the Red-Green test was a metal box measuring 6" X 6" X 3". The front lid was cut out and fitted with a vinyl diffusing screen. Brackets were attached to the lid to hold the Vodnoy #533A near-point slide. The diffusing screen was rear illuminated by a GE 15 watt bulb, the same lighting arrangement the Vodnoy lantern employs. The box was hung from the phoropter reading bar by an adjustable hanger so the box could be levelled relative to the phoropter aperature. See Figure (1), Page (7).

The Vodnoy #533A slide is a laminated 5 ¼ " X 5 ¼ " transparency that incorporates four rows of print and one row that consists of three separate tests. The top row print is 4 ½ point print, the second is 5 point print. The third row consists of, from left to right, a vertical fixation disparity, next a lateral fixation disparity and on the right a red-green test. Below are two more rows of print, a 6 point print row and an 8 point print row. An illustration of the slide is shown in Figure (2), Page (7).

The Duochrome test has four rows of print on each side. The word "Focus" is printed from top to bottom in 8 point print, 6 point print, 5 point print and 4½ point print. The vinyl filters are made by Dupont, the stock numbers being red #392 and green #841. The vinyl filters are 0.02 inches thick. The spectral characteristics of the red-green filters are shown on the following graphs, pages 8 and 9 .

The spectral transmission curves for red #392 filter and green #841 filter are on Graph #1. Graph #2 relates the energy transmission per nanometer from the light source coupled with spectral sensitivity of the standard observer $V\lambda$. This shifted curve is multiplied by the transmission of the red, green filters to give the spectral sensitivity of each filter. Sensitivity to the red and green filters are closely matched and nicely separated at approximately 589 nm.

Diagram of Lantern

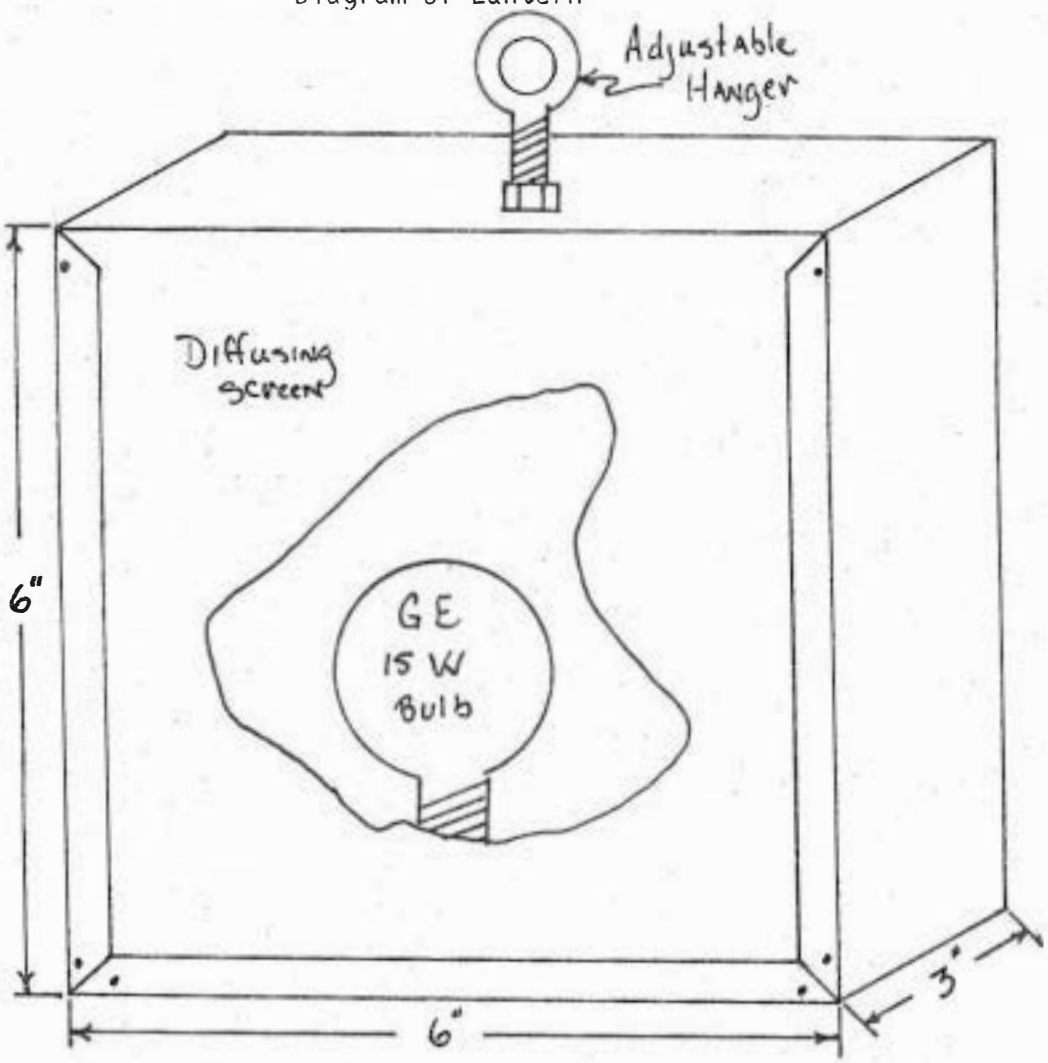
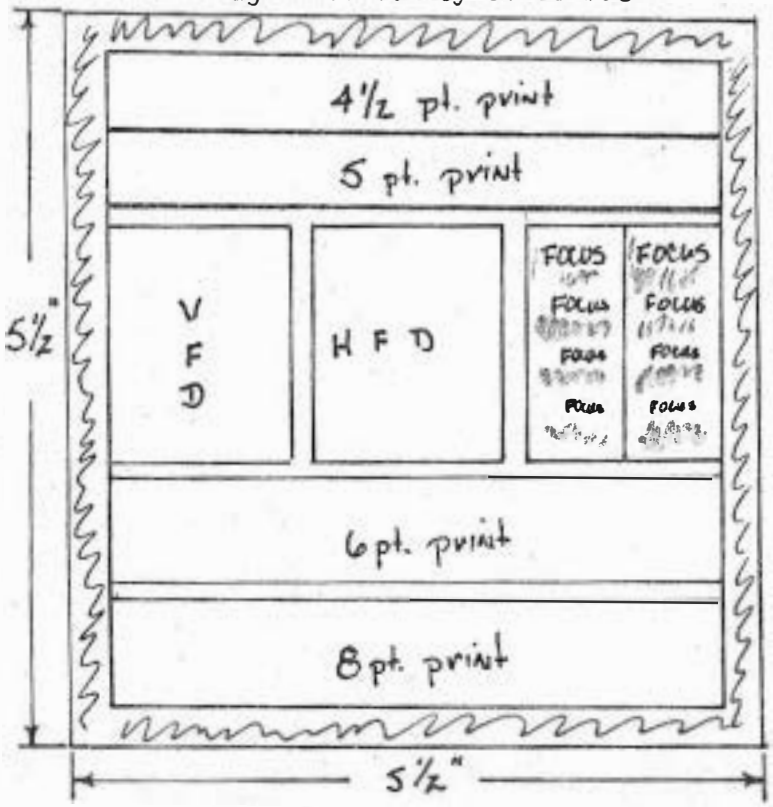
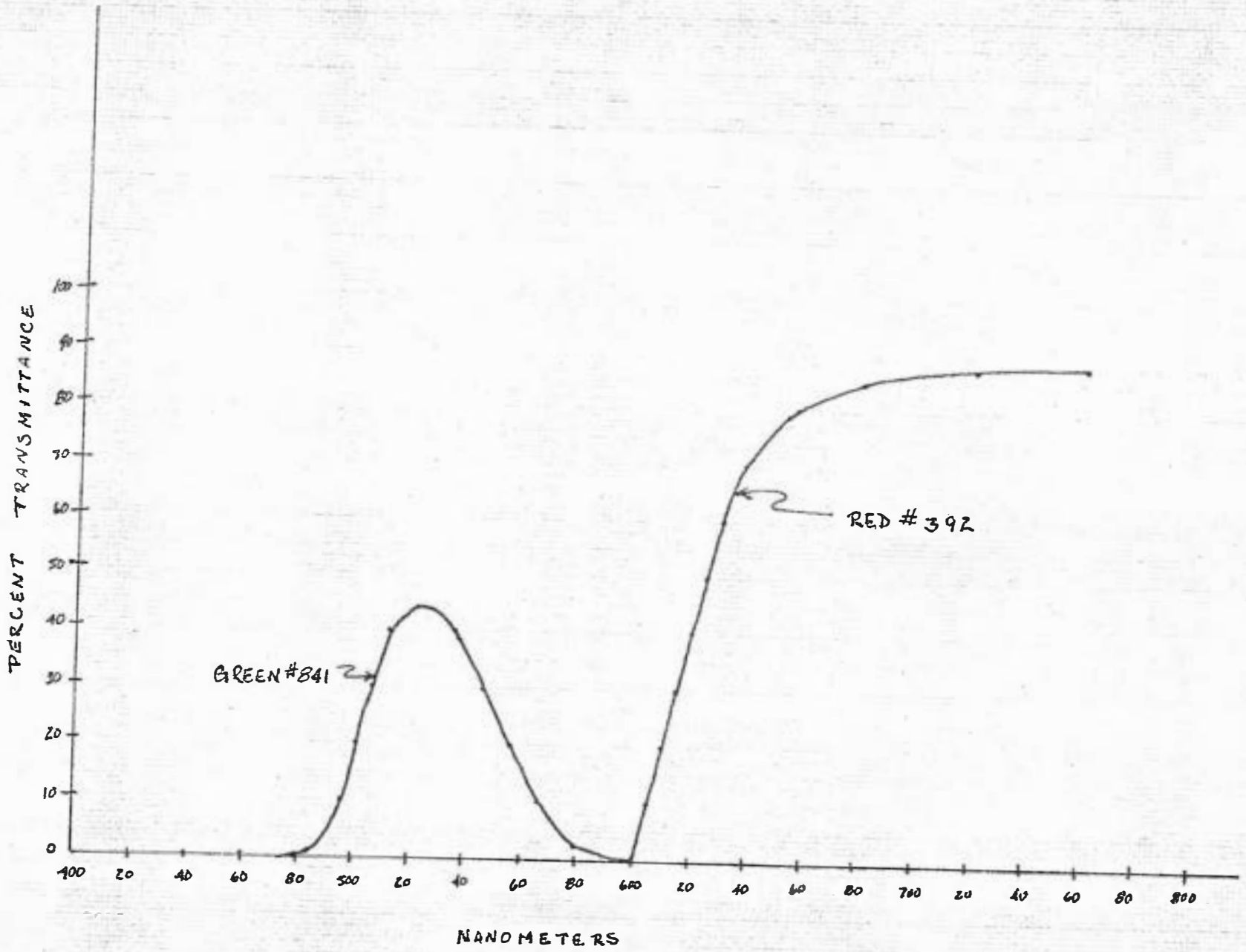


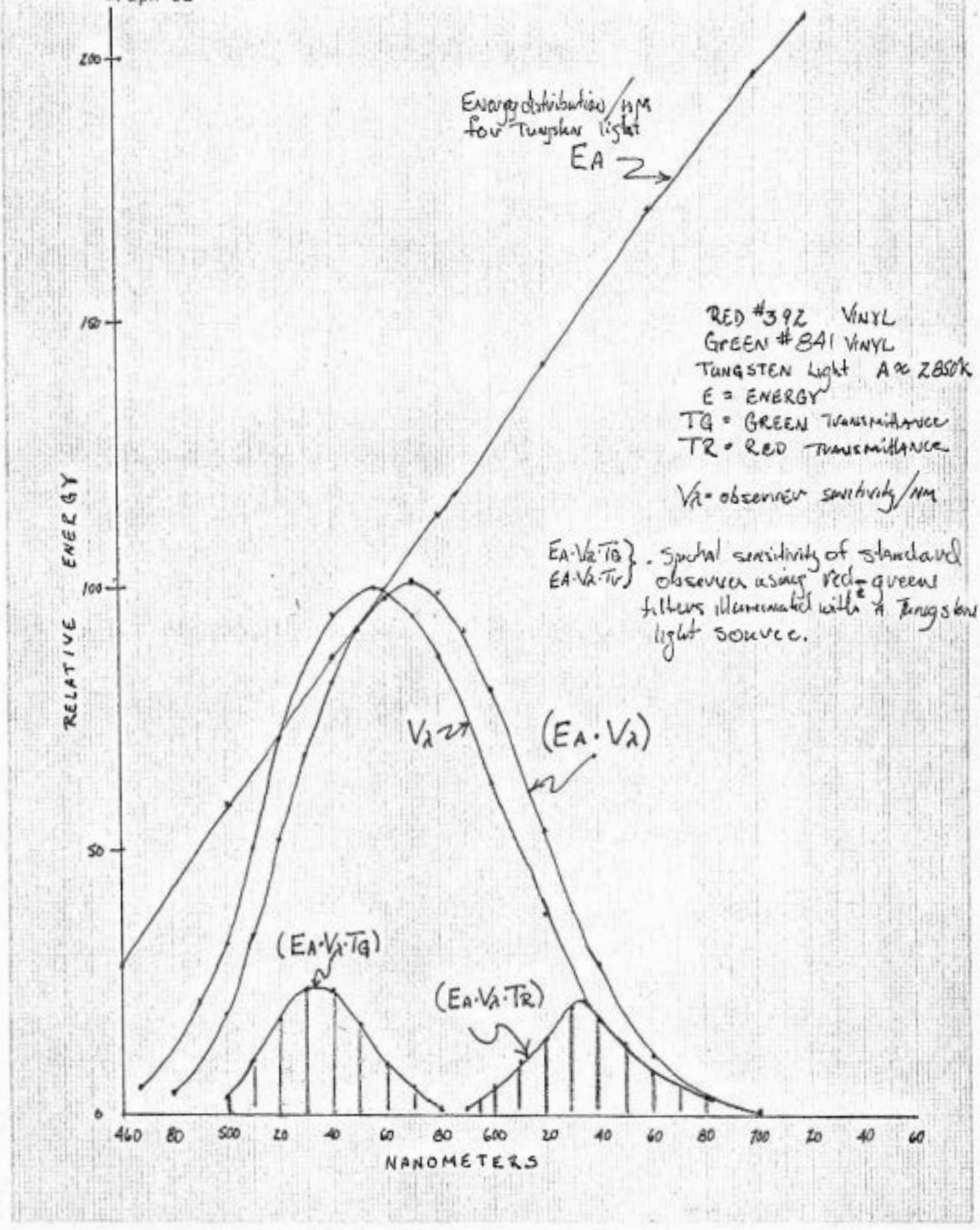
Diagram of Vodnoy Slide #533A



Graph #1: Spectral Transmittance for Red-Green Filters



Graph #2 Spectral Sensitivity Curves for Red-Green Filters



Form No. 810 - 10 Millimeters to Centimeter

EXPERIMENTAL DESIGN

Subject Criteria

The 57 subjects used for our thesis had to meet the following criteria:

1. Best correctable visual acuity 20/20, monocular and binocular.
2. Age -- Over six years and under 40 years old (See Histogram #1)
3. Refractive error:

   Myopia less than -6.00D

   Hyperopia less than +4.00D

   Astigmatism less than 2.00D
4. No tropia
5. No pathology
6. No contact lens wearers

Testing Procedure

The testing procedure consisted of a thirteen test sequence. Room illumination was maintained at a standard 17 fc except for the far and near red-green testing at which time the room illumination was extinguished. Near testing distances were held at sixteen inches. Plus and minus findings were consistently taken for all tests with the plus preset always preceeding the minus preset. Monocular and binocular findings were taken for all tests.

The thirteen test sequence was as follows:

1. Distance and near visual acuity, aided and unaided
2. Keratometry (#2)
3. Static Retinoscopy (#4)
4. Distance Red-green (#7RG)
5. Jackson Cross-cylinder
6. Distance Cross-cylinder (#7cc)
7. Maximum plus to 20/20 (#7)
8. Subjective Best Visual Acuity (#7a)
9. HN - LN dynamic retinoscopy (neutral from against motion-neutral from with motion)
10. Cross-cylinder at near (#14A, 14B)
11. Positive Relative Accommodation (#20)
12. Negative Relative Accommodation (#21)
13. Red - green test at near, using Vodnoy Slide #533A

Interclinician Reliability

The interclinician reliability was assessed on two sets of tests. First, five subjects were used to assess the interclinician reliability on the calculated "P" values. The "P" values were calculated using the following formula:

$$\text{"P"} = \frac{7RG + \#7A + (\#7 - 0.50D + (\#7cc + 0.25D) + \#4}{5}$$

Each of the five subjects were tested on the same evening by all three clinicians. This testing was done as a blind study. The time required for the testing sequence was approximately 45 minutes per patient per clinician. This gave a total of fifteen "P" values.

The second measurement of interclinician reliability consisted of testing the same five subjects five times on the Vodnoy near red-green test by each clinician. This gave a total of fifteen near red-green findings for each of the five subjects, or a total sample of 75 findings to assess the interclinician reliability on the Vodnoy Near Red-Green Test.

Repeatability of Vodnoy Near Red-Green Procedure

The reliability of the Vodnoy near red-green procedure was tested with two different sample sets. The first set consisted of the five subjects used for the interclinican reliability studies. These subjects each were tested fifteen times on the Vodnoy near red-green procedure, five times each by all three clinicians.

The second set consisted of fifteen other subjects from the total test population of 57 subjects. Twelve of these subjects were tested by Greg Walther and three by Robert O'Connell. Each of these fifteen subjects were tested five times on the Vodnoy Near Red-Green procedure. With these two sample sets together we had 150 sets of Vodnoy near red-green findings to determine the reliability of this test.

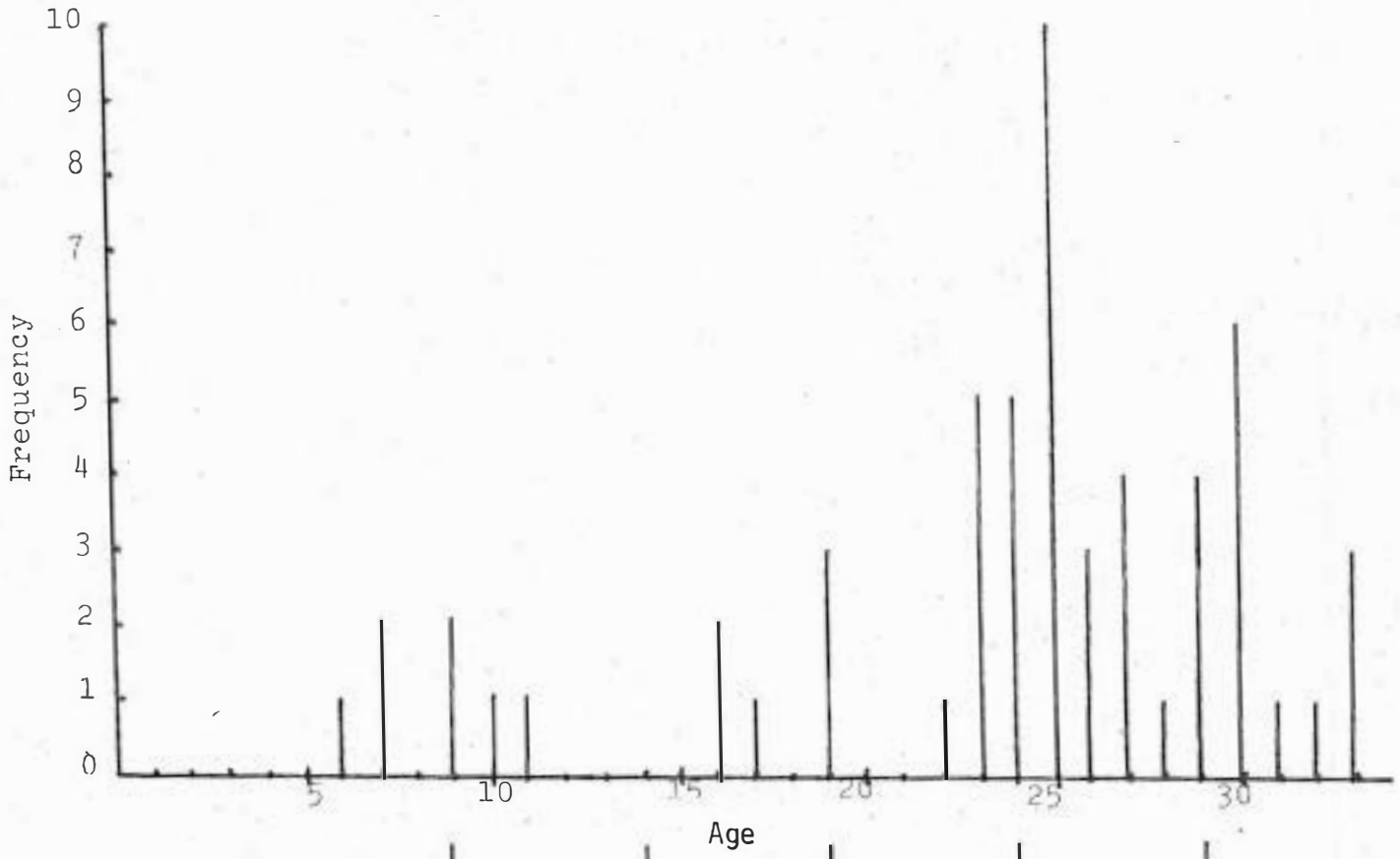
RESULTS

Age Distribution

A total of 57 subjects were studied in various portions of the study. Ages ranged from six years to 35 years of age. The age distribution is displayed in Histogram # 1.

Histogram #1

AGE DISTRIBUTION



Number in age group	5	2	6	11	22	11
Percent	8.7%	3.5%	10.5%	19.3%	38.6%	19.3%

Interclinician Reliability of "P" Value Determination

The "P" value for each of the five subjects was calculated for each of the three times they were tested. The calculated "P" values for each subject on the three testing sequences are shown in Table # 1.

The "P" values for each subject was calculated using the following formula:

$$\text{"P"} = \frac{\#7RG + \#7A + (\#7 - 0.50D) + (\#7cc + 0.25D) + \#4}{5}$$

Interclinician variance from the average spherical "P" value was determined by calculating the standard deviation of each clinician from the average spherical "P" value using the following formula:

$$\text{S. D.} = \sqrt{\frac{\Sigma(\text{Score} - \text{mean score})^2}{n - 1}}$$

The variance was found to be:

Clinician	S. D.	Variance
O'Connell	0.117D	0.014D
Keddington	0.083D	0.007D
Walther	0.083D	0.007D

Comparing the spherical "P" values found by the three clinicians we found an F score of 0.0005. The Critical value for $F_{(2,8)}$ is 8.65. Therefore, the data indicates there was no significant difference found in the distance refraction, "P" value, by the three different clinicians, to the

0.01 level of confidence. Details of the parametric analysis are shown in the appendix on Page 56 .

If all the spherical equivalent "P" value findings from the three clinicans were summed, the mean difference of the spherical equivalent "P" values is found to be 0.07D, median difference of 0.08D, standard deviation of 0.14D, and a variance of 0.019D.

The mean difference in the spherical equivalent "P" values between the three examiners on the five reliability subjects was 0.20D, the median difference was 0.125D, and the standard deviation was 0.276D. This indicates that 95 per cent of the time two clinicians were within 0.54D on any two measurements of "P".

Subject (MWf) contributed the greatest to the dispersion of scores (See Table 1). Without this one subject whose responses are atypical in a standard population, the interclinician reliability would have been considerably better than was found.

Table #1

"P" Value in O.D. used for Interclinician Reliability

Raw Score
Spherical Equivalent

Subject \ Examiner	RO	JK	GW	AVERAGE "P"
AO	-0.25	PL	PL	-0.083
RP	+.50 - .25 x 135 / +0.37	+.50 - .25 x 125 / +0.37	+.75 - .50 x 120 / +0.50	+.58 - .25 x127 / +0.42
DF	-4.37 - .25 x 35 / -4.50	-4.50 - .25 x 35 / -4.50	-4.50 -.25 x 45 / -4.62	-4.46 - .25 x3 / -4.54
EH	-.37 - .25 x 05 / -0.50	PL - .25 x 20 / -0.12	-.12 - .25 x 35 / -0.25	-.16 - .25 x 2 / -0.29
MW	-.37 -.75 x 80 / -0.75	-.25 - .25 x 75 / -0.37	-.62 - .75 x 85 / -1.00	-.41 - .58 x 80 / -0.71
T =	-4.86	-4.25	-4.49	G = 13.62
X^2 =	19.68	20.56	21.21	

Interclinician Reliability on the Vodnoy Near Red-Green Test

The difference between clinicians on the near red-green findings taken for each of five subjects were computed and are displayed on Table 5. The mean, median and standard deviation were calculated for each of the following sets of clinicians:

1) R. O. - J. K.

2) R. O. - G. W.

3) G. W. - J. K.

"F" was calculated for each difference between the pairs of clinicians as follows:

$$"F"_{obs} = \frac{\text{MS measured}}{\text{MS treatments}}$$ (refer to linear regression between tests for details)

$$F_{R.\,O. - J.\,K.} = \frac{.344^2}{.197^2} = 2.87$$

$$F_{R.\,O. - G.\,W.} = \frac{.236^2}{.197^2} = 1.435$$

$$F_{G.\,W. - J.\,K.} = \frac{.344^2}{.236^2} = 2.12$$

The "F" Value for $"F"_{R.\,O. - J.\,K.}$ was significant to the 0.01 level of confidence. The $"F"_{R.\,O. - G.\,W.}$ was below the 0.05 level of

confidence, and the "F" was significant to the 0.05 level
G. W. - J. K.
of confidence. This statistical analysis is shown in Table 2.

The mean and median indicate no difference between examiners. The design of the experiment does not allow us to determine if the differences in variance in the Red-Green findings result from examiner variation or change in subject behavior or a function of repeated measurement. This portion of the test was not counterbalanced. Inspection of the data indicated subject M.W. increasing in variability during the testing.

Table #2

INTERCLINICIAN RELIABILITY ON NEAR RED-GREEN

	RO-JK					RO-GW					JK-GW				
T	f	d	fd	d^2	fd^2	f	d	fd	d^2	fd^2	f	d	fd	d^2	fd^2
0D	4	0	0	0	0	5	0	0	0	0	4	0	0	0	0
.12D	5	1	5	1	5	5	1	5	1	5	4	1	4	1	4
.25D	4	2	8	4	16	4	2	8	4	16	8	2	16	4	32
.37D	9	3	27	9	81	3	3	9	9	27	3	3	9	9	27
.50D	1	4	4	16	16	0	4	0	16	0	2	4	8	16	32
.62D	0	5	0	25	0	1	5	5	25	25	3	5	15	25	75
.75D	2	6	12	36	72	3	6	18	36	108	0	6	0	36	0
.87D						1	7	7	49	49	0	7	0	49	0
1.00D						3	8	24	64	192	0	8	0	64	0
1.12D											1	9	9	81	81
	25		56		190	25		76		422	25		63		251
	F=	$\frac{(.344)^2}{(.197)^2}$ = .287 .01				F=	$\frac{(.236)^2}{(.197)^2}$ = 1.435 .05				F=	$\frac{(.344)^2}{(.236)^2}$ = 2.12 .05			
Med.	0.25D					0.25D					0.25D				
Mean	0.34D					0.42D					0.37D				
S. D.	0.197D					0.344D					0.236D				

Near Point Red-Green Test-Retest Reliability

Test-retest reliability was calculated with data taken with the Vodnoy Near point red-green test. The original five reliability subjects were each measured five times by each of the three clinicians to yield 75 findings. Fifteen more subjects were measured five times each giving 75 more measurements. The total number of subjects was twenty, producing 150 separate measurements. Multiple comparisons within a subjects' individual findings were made giving a total of 300 differences. These bits of data represented the absolute difference between an individual's test measurements for the near point red-green tests. Each individual's near red-green scores were compared to each other. The algebraic difference between all possible pairs of an individual's findings was calculated, i. e., Test 1 - Test 2, Test 1 - Test 3. This data appears on Tables 4 and 5. Histogram #2 shows the distribution of the differences.

N = 300 differences (150 findings)

Mean = 0.11D

Median = 0.18D

Mode = 0.00D

S. D. = 0.211D

Variance = 0.044D

Repeatability of Vodnoy Near Red-Green Test

Each of the five subjects fifteen near findings were averaged. The difference from each subject's mean value was determined by calculating the standard deviation of each subject's near red-green findings from the mean by the following formula:

$$\text{S. D.} = \sqrt{\frac{\Sigma(\text{Finding} - \text{Mean})^2}{N - 1}}$$

The subjects were found to have the following variance:

Subject	S. D.	Variance
Hartman, E.	0.024D	.0005D
Flemmons, D.	0.034D	.001D
Peterson, R.	0.092D	.008D
O'Connell, A.	0.339D	.115D
Walther, M.	1.01D	1.02D

The inter-subject variance was calculated as follows:

$$\text{Intersubject S. D. Summed} = \frac{\text{S.D.}_{\text{A.O.}} + \text{S.D.}_{\text{E.H.}} + \text{S.D.}_{\text{D.F.}} + \text{S.D.}_{\text{R.P.}} + \text{S.D.}_{\text{M.W.}}}{5}$$

$$(\text{Intersubject S. D.})^2 = \text{Variance}$$

The intersubject variance summed was found to be $(0.146D)^2 = 0.0213D$ which is much smaller than the minimum measurement unit of 0.25D. (See Table 5 for the difference between these five subjects Near Red-Green findings.)

It is of interest to note that of the twenty subjects used to assess test - retest reliability on the Near Red-Green test there was only one subject that showed a variance greater than 0.37D. This one subjects (MW) responses tend to bias the findings toward greater variability. Without this one subject, the repeatability of the test would have been much better.

This one subject was also included in the sample of five subjects who were tested fifteen times each to analyze subject variability. We believe this one subjects variance is atypical and since the reliability was good even with this subjects high variance, the test is extremely reliable.

Table #3

ACCOMMODATIVE LAGS OR FIVE SEQUENTIAL RED-GREEN TESTS FOR TWENTY SUBJECTS

Subject	Examiner	Test #1	Test #2	Test #3	Test #4	Test #5
E H	G W	+1.00	+1.00	+1.12	+1.12	+1.00
E H	R O	+0.75	+0.75	+0.75	+0.75	+0.87
E H	J K	+1.00	+1.12	+1.25	+1.12	+1.25
D F	G W	+1.62	+1.37	+1.37	+1.37	+1.37
D F	R O	+1.25	+1.37	+1.37	+1.50	+1.37
D F	J K	+1.37	+1.62	+1.75	+1.62	+1.62
R P	G W	+1.50	+1.37	+1.37	+1.25	+1.37
R P	R O	+1.25	+1.25	+1.12	+1.25	+1.25
R P	J K	+1.25	+1.37	+1.25	+1.25	+1.12
A O	R O	+0.75	+0.87	+0.75	+0.75	+0.75
A O	J K	+1.00	+1.12	+1.12	+1.12	+1.12
A O	G W	+1.37	+1.75	+1.75	+1.62	+1.75
M W f	G W	+0.25	+0.75	-0.75	+0.12	+0.25
M W f	R O	+0.37	+0.75	+0.50	+0.25	-0.50
M W f	J K	+1.12	+1.12	+0.87	0.0	0.0
R H	R O	+1.50	+1.50	+1.50	+1.50	+1.50
J G	R O	+1.00	+0.75	+1.00	+1.00	+1.00
C J	R O	+2.12	+2.00	+2.00	+2.12	+2.00
B H	G W	+1.62	+1.75	+1.75	+1.75	+1.75
D M	G W	+1.75	+1.87	+2.00	+2.00	+2.00
J H	G W	+1.87	+1.87	+1.87	+1.87	+1.87
L H	G W	+1.75	+1.75	+1.75	+1.75	+1.75
A D	G W	+1.25	+1.50	+1.50	+1.50	+1.50
G D	G W	+1.12	+1.12	+1.12	+1.12	+1.12
M W m	G W	+1.25	+1.25	+1.25	+1.25	+1.25
M H	G W	+0.87	+0.62	+0.87	+0.87	+0.87
M M	G W	+1.50	+1.50	+1.50	+1.50	+1.50
B F	G W	+1.50	+1.50	+1.50	+1.50	+1.50
D T m	G W	+1.25	+1.25	+1.25	+1.12	+1.25
D T f	G W	+1.00	+1.00	+1.00	+1.00	+1.00

Table #4

DIFFERENCES BETWEEN SEQUENTIAL NEAR RED GREEN TESTS WITHIN SUBJECTS

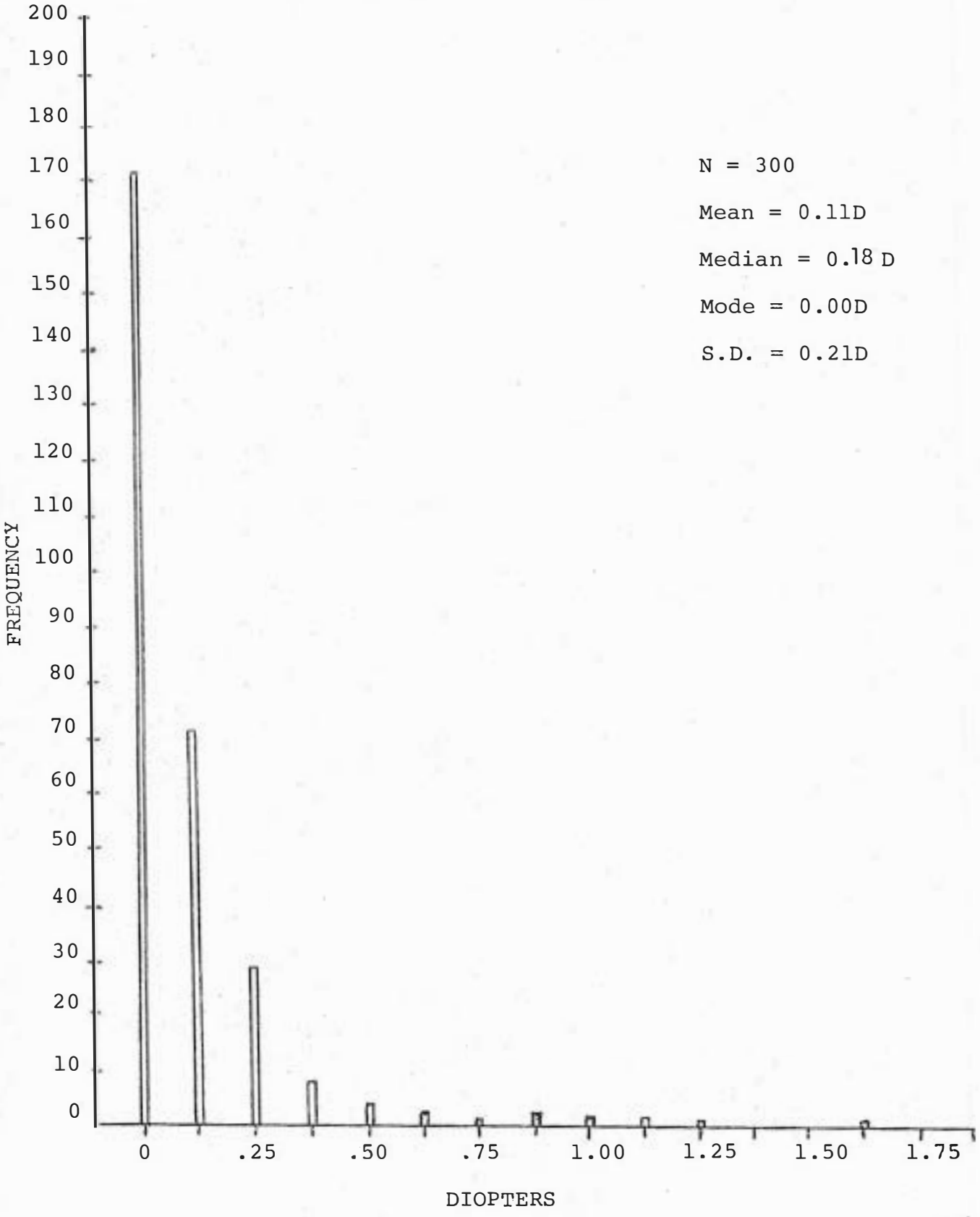
Subject	Examiner	1-2	1-3	1-4	1-5	2-3	2-4	2-5	3-4	3-5	4-5
JG	RO	0	0	0	0	0	0	0	0	0	0
RH	RO	+0.25	0	0	0	-0.25	-0.25	-0.25	0	0	0
CJ	RO	+0.12	+0.12	0	+0.12	0	-0.12	0	-0.12	0	+0.12
BH	GW	-0.12	-0.12	-0.12	-0.12	0	0	0	0	0	0
DM	GW	-0.12	-0.25	-0.25	-0.25	-0.12	-0.12	-0.12	0	0	0
JH	GW	0	0	0	0	0	0	0	0	0	0
LH	GW	0	0	0	0	0	0	0	0	0	0
DD	GW	-0.25	-0.25	-0.25	-0.25	0	0	0	0	0	0
GD	GW	0	0	0	0	0	0	0	0	0	0
MWM	GW	0	0	0	0	0	0	0	0	0	0
MH	GW	+0.25	0	0	0	-0.12	-0.12	-0.12	0	0	0
MM	GW	0	0	0	0	0	0	0	0	0	0
BF	GW	0	0	0	0	0	0	0	0	0	0
DTM	GW	0	+0.12	0	0	+0.12	0	0	0	0	0
DTF	GW	0	0	0	0	0	0	0	0	0	0

DIFFERENCE BETWEEN NEAR RED-GREEN TESTS AMONG CLINICIANS AND SUBJECTS Table #5

SUB	EX	1-2	1-3	1-4	1-5	2-3	2-4	2-5	3-4	3-5	4-5
EH	RO	0	0	0	-.12	0	0	-.12	0	-.12	-.12
EH	JK	-.12	-.25	-.12	-.25	-.12	0	-.12	+.12	0	-.12
EH	GW	0	-.12	-.12	0	-.12	-.12	0	0	+.12	+.12
DF	RO	-.12	-.12	-.25	-.12	0	-.12	0	-.12	0	+.12
DF	JK	-.25	-.37	-.25	-.25	-.12	0	0	+.12	+.12	0
DF	GW	+.25	+.25	+.25	+.25	0	0	0	0	0	0
RP	RO	0	+.12	0	0	+.12	0	0	-.12	-.12	0
RP	JK	-.12	0	0	+12	+.12	+.12	+.25	0	+.12	+.12
RP	GW	+.12	+.12	+.25	+.12	0	+.25	0	+.12	0	-.12
AO	RO	-.12	0	0	0	-.12	-.12	-.12	0	0	0
AO	JK	-.12	-.12	-.12	-.12	0	0	0	0	0	0
AO	GW	-.37	-.37	-.25	-.37	0	+.12	0	+.12	0	-.12
MW	RO	+.37	+.62	+.87	+1.62	+.25	+.50	+1.25	+.25	+1.00	+.75
MW	JK	-.75	-.50	+.37	+.37	+.25	+1.12	+1.12	+.87	+.87	0
MW	GW	-.62	+.37	0	-.12	+1.00	+.62	+.50	-.37	-.50	-.12

HISTOGRAM #2

NEAR RED-GREEN REPEATABILITY WITH TWENTY SUBJECTS



Distribution of difference between near Red - Green tests within each of twenty subjects.

Histograms of Accommodative Lags

The accommodative lags measured from "P" for the five near tests are shown on Histograms #3-8. Operationally, the accommodative lag is the difference between each near test gross sphere minus the "P" value (distance refraction). The accommodative response under each test condition for each subject may be obtained from the following equation:

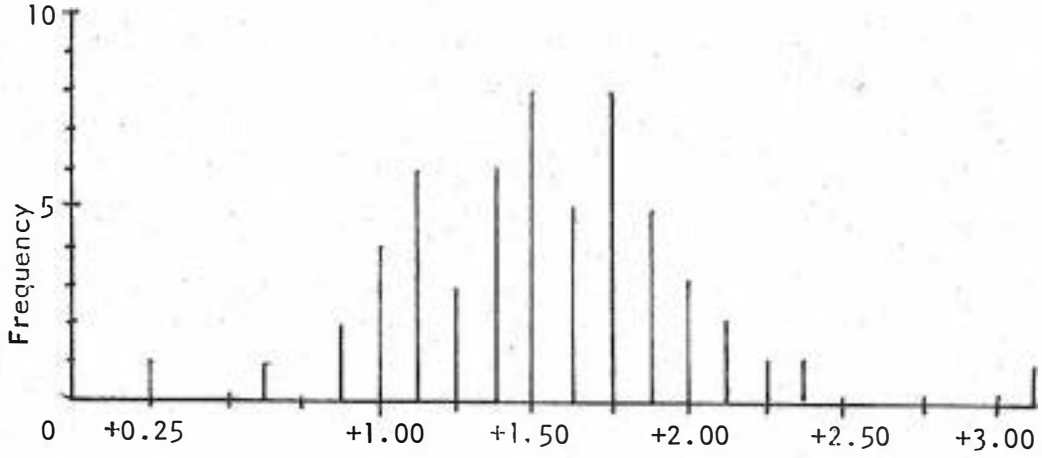
$$\text{ACCOMMODATIVE RESPONSE} = \frac{1}{D} - (\text{Gross finding} - \text{"P"})$$

$$= 2.5 - \text{Accommodative lag}$$

The mean, median, mode and standard deviations are listed for the five tests in order of the most to the least plus on Table #6.

A bar graph showing the means of the five near tests and the standard deviation is shown in Graph # 4, page 51.

Histogram #3

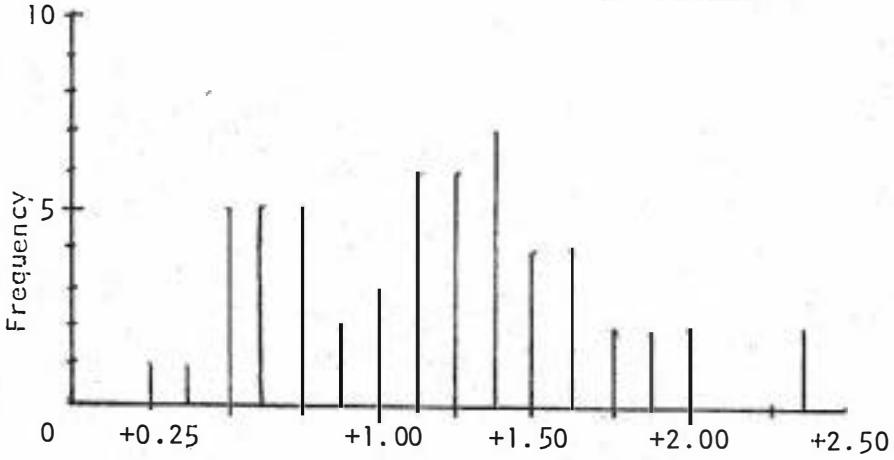


Red-Green - P

N = 57
Mode = Multimodal
Mean = +1.47 D
Median = +1.31 D
Standard Deviation= 0.46 D

Diopters

Histogram #4

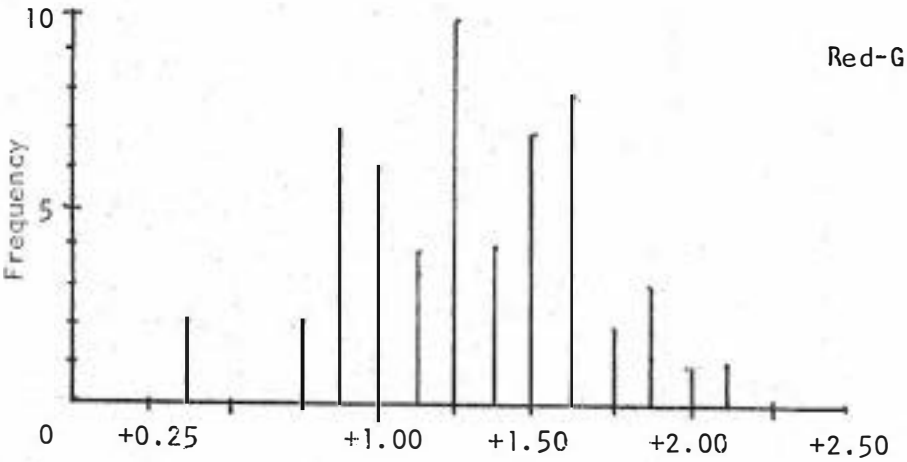


14B - P

N = 57
Mode = +1.37 D
Mean = +1.17 D
Median = +1.31 D
Standard Deviation= 0.52 D

Diopters

Histogram #5

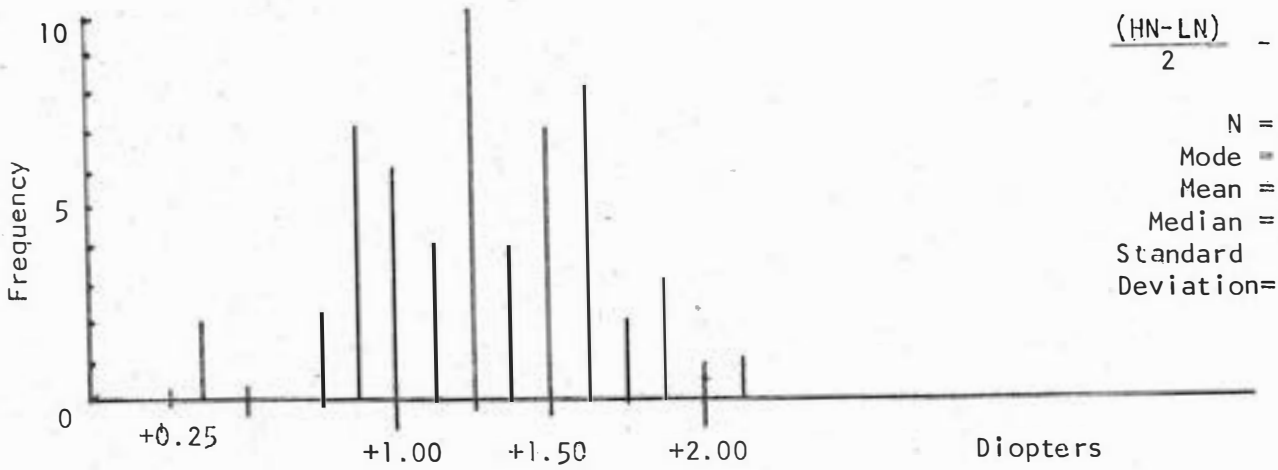


Red-Green - High Neutral Low Neutral Balance - P

N = 57
Mode = +1.25 D
Mean = +1.32 D
Median = +1.25 D
Standard Deviation= 0.38 D

Diopters

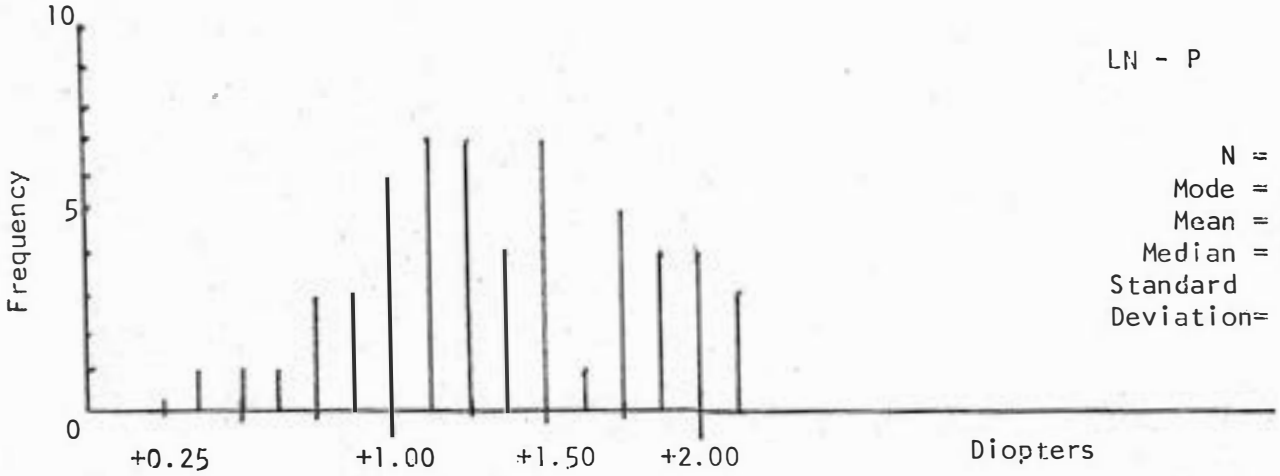
HISTOGRAM # 6



$\frac{(HN-LN)}{2}$ - P

N = 57
Mode = +1.25 D
Mean = +1.32 D
Median = +1.25 D
Standard
Deviation= 0.38 D

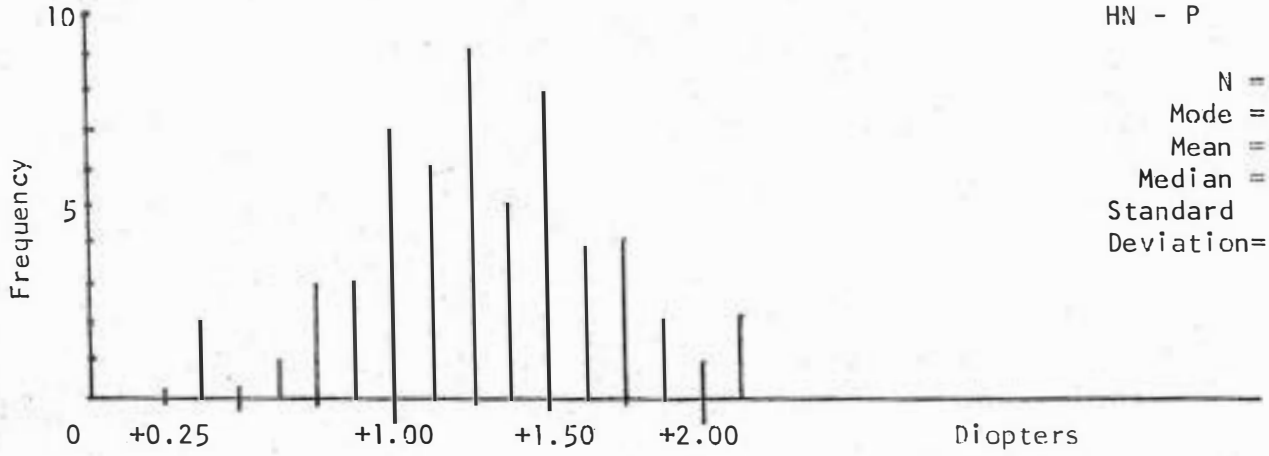
HISTOGRAM # 7



LN - P

N = 57
Mode = Multimodal
Mean = +1.33 D
Median = +1.25 D
Standard
Deviation= 0.44 D

HISTOGRAM # 8



HN - P

N = 57
Mode = +1.25 D
Mean = +1.27 D
Median = +1.25 D
Standard
Deviation= 0.39 D

Histogram #3

Histogram #2 displays the algebraic difference between the Near Red-Green (RG) findings and the distance "P" value. Inspection of this histogram shows a consistent response of greater plus than the "P" power for all subjects. The mean difference was found to be +1.62D. This indicates that the accomodative response on the RG test was always somewhat less than the demand of 2.50D with the average response being 0.87D.

Histogram #4

Histogram #3 displays the algebraic difference between the Near Cross Cylinder Balance (14B) and the distance "P" power. Inspection of this histogram shows that all responses on the 14B test were of greater plus than the distance refraction with a mean value of 1.125D. This indicates that the accommodative response on the 14B test was less than the demand of 2.5D but was greater than that found with the RG or with the LN and HN retinoscopy. The average accommodative response on the 14B test was found to be slightly less than 1.50D.

Histogram #5 and #6

Histograms #4 and #5 show the same relationship, which is the algebraic difference between the High Neutral - Low Neutral Retinoscopy balance and the distance "P" power. Analysis of these histograms shows that the findings on the HN-LN were an average of 1.37D more plus than the distance refraction. Analysis shows the accommodative response on the HN-LN was less than the demand of 2.5D with an average response of 1.12D.

Table #6

Statistical Analysis of Accommodative Lags of Five Near Tests

Tests	Mean	Median	Mode	Standard Deviation	# of Subjects
RG - P	+1.47 D	+1.31 D	Multimodal	0.46 D	57
LN - P	+1.33 D	+1.25 D	Multimodal	0.44 D	57
$\frac{LN + HN}{2}$ -P	+1.32 D	+1.25 D	+1.25	0.38 D	57
HN - P	+1.27 D	+1.25 D	+1.25	0.39 D	57
14B - P	+1.17 D	+1.31 D	+1.37	0.52 D	57

Table #6 shows the statistical analysis of the accommodative lags for the five near tests, as shown in histograms #3-8.

Subject	HN + LN − P / 2	HN - P	LN - P	14B - P	RG - P	P
RM	+0.87	+0.75	+1.00	+1.12	+2.00	-3.25
DM	+1.37	+1.12	+1.62	+1.50	+1.87	+0.37
BG	+0.87	+1.00	+0.75	+0.62	+1.12	+0.25
JH	+2.00	+2.12	+1.87	+1.62	+1.87	+0.37
LH	+1.12	+1.12	+1.12	+2.00	+1.75	+0.12
DD	+1.00	+1.12	+0 87	+0.75	+1.50	+0.12
HI	+0.87	+1.00	+0.75	+0.37	+0.25	+0.50
BB	+1.50	+1.75	+1 25	+1.25	+2.12	-0.25
GB	+1.25	+1.25	+1.25	+1.12	+1.50	+0.25
AD	+1.37	+1.37	+1.37	+1.12	+1.87	-5.62
GD	+1.25	+1.25	+1.25	+1.37	+1.12	-0.50
MWM	+1.87	+1.62	+2.12	+1.37	+1.25	-5.37
GK	+2.12	+2.12	+2.12	+1.75	+1.75	-0.62
MH	+1.00	+1.00	+1.00	+1.12	+1.37	-0.50
MM	+1.25	+1.25	+1.25	+0.75	+1.50	+0.75
JT	+1.50	+1.37	+1.62	+1.37	+1.50	+0.62
BF	+0.75	+0.62	+0.87	+1.50	+1.50	+1.50
DTM	+1.87	+1.87	+1.87	+1.12	+1.25	-0.12
DTF	+1.62	+1.50	+1.75	+0.62	+1.00	-4.50
RO	+0.75	+0.75	+0.75	+1.25	+1.25	-1.75
JK	+1.00	+1.00	+1.00	+1.37	+1.37	+0.25
EH	+0.87	+1.75	+1.50	+0.50	+0.87	-0.12
AO	+1.37	+1.75	+1.50	+0.50	+1.12	plano
RP	+1.25	+1.00	+0.50	+0.37	+1.37	+0.62
DF	+1.50	+1.37	+1.37	+1.62	+1.37	-4.50
MW F	+1.12	+0.75	+1.00	+0.75	+1.12	-0.37

Table #7

Subject	$\frac{HN + LN}{2}$ - P	HN - P	LN - P	14B - P	RG - P	P
JG	+0.87	+0.87	+0.87	+1.00	+1.50	+0.12
RH	+1.62	+1.87	+1.37	+0 87	+1.00	-0.87
CJ	+1.62	+1.50	+1.75	+1.50	+2 00	plano
KOF	+1.62	+2.00	+1.75	+1.12	+1.87	+0.75
KOM	+1.62	+1.25	+2.00	+1.62	+2.37	+1.50
KL	+1.50	+1.50	+1.50	+0 62	+1.12	+0.25
JE	+1.37	+1.37	+1.37	+2.37	+1.75	-2.37
NE	+1.62	+1.50	+1.75	+0.50	+1.62	+0 25
GK	+1.62	+1.37	+1.87	+1.37	+1.75	+0.12
KL	+1.87	+1.75	+2.00	+1.25	+1.75	-0.25
JO	+1.75	+1.62	+1.87	+1.87	+1.75	-0.12
BH	+1.12	+1.12	+1.12	+1.25	+1.62	-0 62
SH	+1.25	+1.25	+1.00	+1.25	+1.37	-2.75
JD	+1.25	+1.25	+1.50	+1.62	+1.62	+0.25
HB	+1.25	+1.50	+1.50	+1.75	+1.62	plano
BP	+0.87	+0.87	+0.87	+0.25	+0.62	+0.62
TH	+1.25	+1.25	+1.50	+0.75	+1.12	+0.37
MG	+1.50	+1.50	+1.75	+1.25	+1.50	plano
SK	+1.12	+1.12	+1 12	+0.75	+1.37	+0.37
SH	+1.50	+1.50	+1.25	+2.00	+2.25	+2.00
JW	+0.37	+0.37	+0.62	+0.50	+1.00	-0.37
JF	+1.25	+1.25	+1.50	+1.37	+2.00	plano
RH	+1.12	+1.12	+1.12	+0.62	+0.87	-0.12
IH	+1.00	+1.00	+1.25	+0.87	+1.00	+0.50
BR	+1.00	+1.00	+1.00	+1.00	+1.62	+0.75
GC	+1.62	+1.62	+1.12	+1.50	+1.75	-1.37
KK	+1.50	+1.50	+2 00	+2 37	+2.12	-0.50
LC	+1.25	+1.25	+1.25	+1.37	+1.87	-3.50
DC	+1.75	+1.75	+2.00	+1.87	+3.12	-2.00
TM	+0.37	+0.37	+0.37	+1.00	+1.50	-0.62
LN	+0.87	+0.87	+1.12	+0,50	+1.75	-2.00

From inspection of the five histograms one can see that the Near Red-Green findings were consistently the most plus. The other findings were found to have decreasing amounts of plus with the Low Neutral Retinoscopy the next most plus followed by the balance of High and Low Neutral Retinoscopy, followed by the High Neutral Retinoscopy, and the Near Cross Cylinder test findings yeilding the least amount of plus. None of the accomodative lags thus determined from the different methods were found to be equivalent. Three possible hypothesis for these differences are:

1. Changes in random variation
2. Differential accommodative response to different accommodative stimulus in the three tests
3. Systematic changes as a function of drift over time

Histograms of Near Test Relationships

Histograms #9-13 show the distribution of the algebraic differences between the five near tests.

Histogram #9

Histogram #7 shows the difference between the Near Red-Green test findings and the midrange between the High - Low Neutral Dynamic Retinoscopy.

Histogram #10

Histogram #8 shows the difference between the Near Red-Green test findings and the Near Cross Cylinder balance (14B).

Histogram #11

Histogram #9 shows the difference between the balance of the High-Low Neutral Dynamic Retinoscopy and the Near Cross Cylinder balance (14B) findings.

Histogram #12

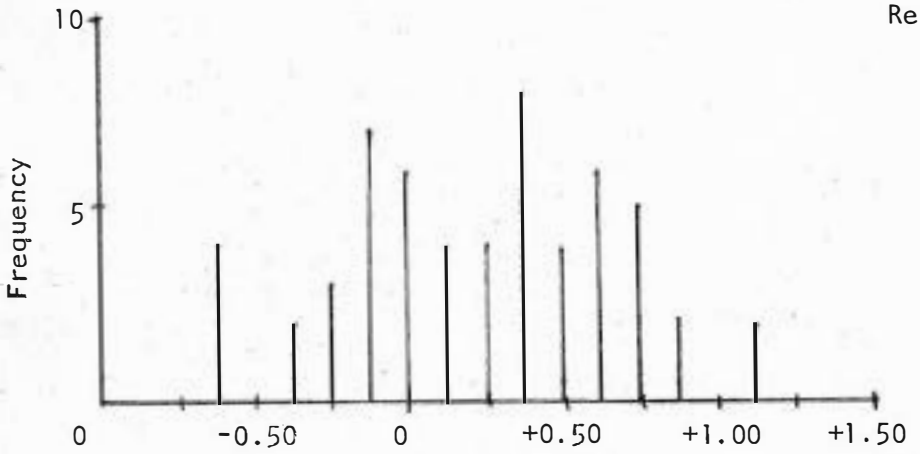
Histogram #10 shows the difference between the Low Neutral Retinoscopy (LN) and the Near Cross Cylinder balance (14B) findings.

Histogram #13

Histogram #11 shows the difference between the High Neutral Retinoscopy (HN) and the Near Cross Cylinder balance (14B) findings.

The statistical analysis of the differences between the five near tests are shown on Table #8.

Histogram #9

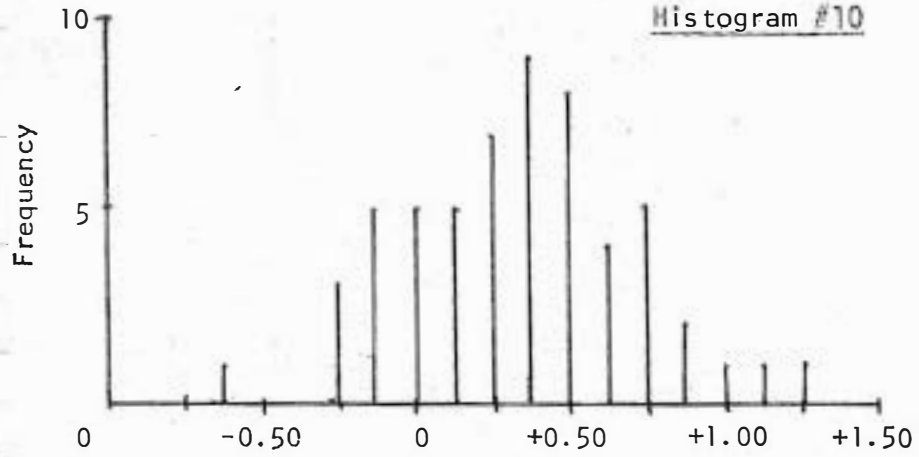


Red-Green - High Neutral Low Neutral Balance

N = 57
Mode = +0.37D
Mean = +0.23D
Median = +0.25D
Standard Deviation = 0.64D

Diopters

Histogram #10

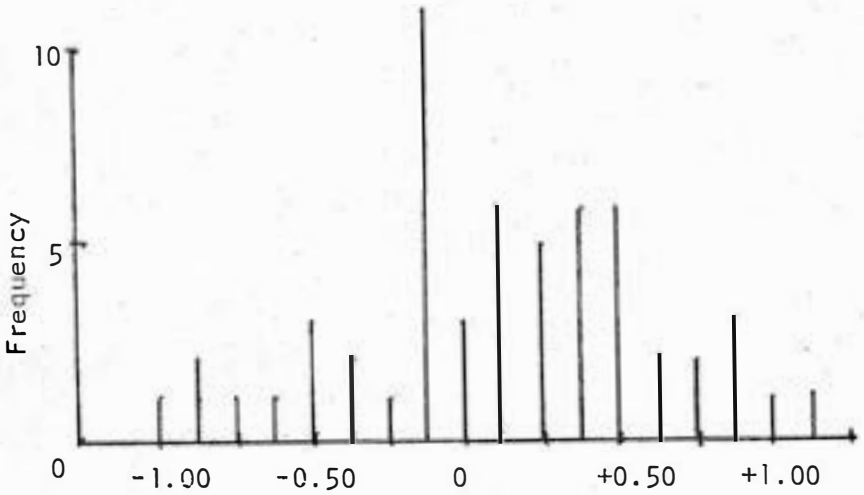


Red-Green - 14B

N = 57
Mode = +0.37 D
Mean = +0.34 D
Median = +0.35 D
Standard Deviation = 0.38 D

Diopters

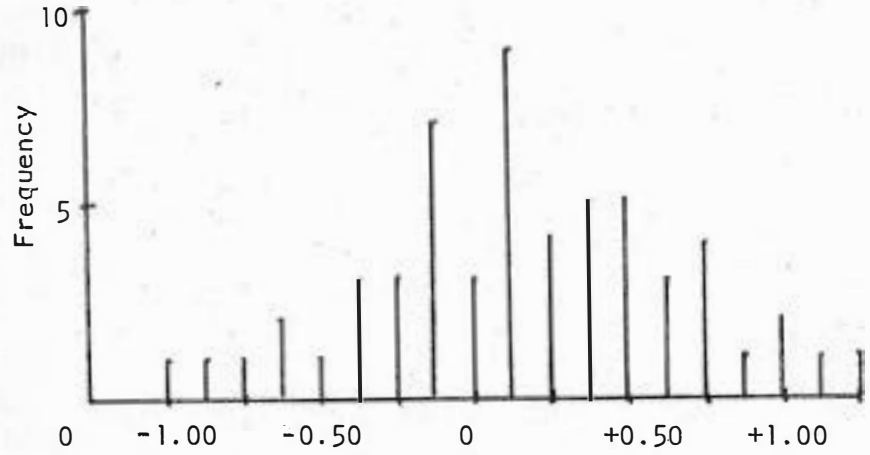
Histogram #11



$\frac{(LN-HN)}{2}$ - 14B

N = 57
Mode = -0.12 D
Mean = +0.06 D
Median = +0.06 D
Standard Deviation= 0.48 D

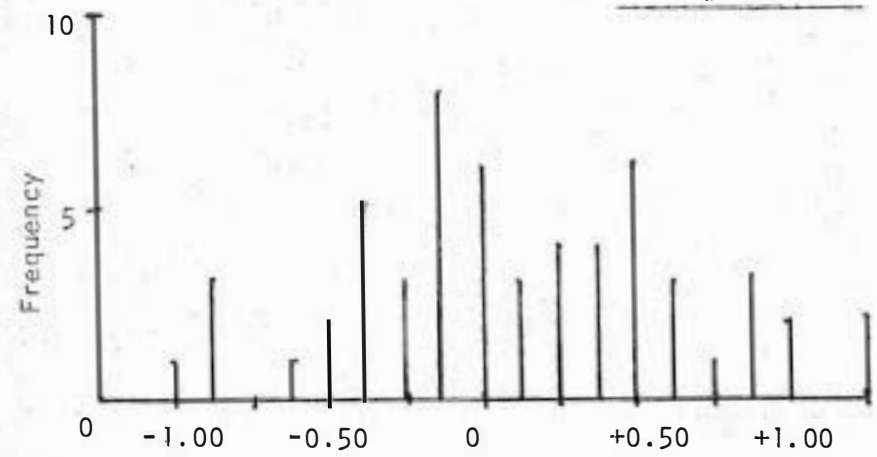
Histogram #12



LN - 14B

N = 57
Mode = +0.12 D
Mean = +0.16 D
Median = +0.12 D
Standard Deviation= 0.49 D

Histogram #13



HN - 14B

N = 57
Mode = -0.12 D
Mean = +0.14 D
Median = +0.12 D
Standard Deviation= 0.53 D

Table #8

Differences Between Five Near Tests

Tests	Mean	Median	Mode	Standard Deviation	# of Subjects
RG - 14B	+0.34 D	+0.35 D	+0.37 D	0.38 D	57
RG - $\frac{(LN-HN)}{2}$	+0.23 D	+0.25 D	+0.37 D	0.64 D	57
LN - 14B	+0.16 D	+0.12 D	+0.12 D	0.49 D	57
HN - 14B	+0.14 D	+0.12 D	-0.12 D	0.53 D	57
$\frac{LN-HN}{2}$ - 14B	+0.06 D	+0.06 D	-0.12 D	0.48 D	57

This table shows the statistical analysis of the differences between the five near tests as displayed on histograms #9-13.

Table #9 displays the distribution of the differences between the five near tests in a numerical fashion. We assumed that a difference between any two tests of 0.12D or less indicated no difference since this is within the error of measurement. Then we compared the number of differences that were greater in plus or minus than 0.12D. We found a specific relationship between the near tests, the same as that indicated by the statistical analysis. These summed differences of greater plus or minus are shown on the bottom of Table # 9. The probability of any of these distributions occuring by chance is less than the .04 level.

Table #9: Distribution of the Differences Between the Lags of the Five Near Tests

	RG - 14B	RG - $\frac{LN-HN}{2}$	$\frac{LN-HN}{2}$ - 14B	HN-14B	LN-14B
-1.25 to -1.37D	0	0	0	0	0
-1.00 to -1.12D	0	0	1	1	1
-0.75 to -0.87D	0	0	3	3	2
-0.50 to -0.62D	1	4	4	3	3
-0.25 to -0.37D	3	5	3	8	6
0 $\pm$ 0.12D	15	17	20	17	19
+0.25 to +0.37D	16	12	11	8	9
+0.50 to +0.62D	12	10	8	9	8
+0.75 to +0.87D	7	7	5	4	5
+1.00 to +1.12D	2	2	2	2	3
+1.25 to +1.37D	1	0	0	2	1
+1.50 to +1.62D	0	0	0	0	0
+1.75 to +1.87D	0	0	0	0	0
TOTAL	57	57	57	57	57
Greater Minus THan -0.12D	4	9	11	15	12
Greater Plus Than +0.12D	38	31	26	25	26
Within $\pm$ 0.12D	15	17	20	17	19

Subject	RG - 14B	RG - $\frac{LN+HN}{2}$	$\frac{LN+HN}{2}$ - 14B	HN - 14B	LN - 14B
JG	+0.50	+0.87	-0.12	-0.12	-0.12
RH	+0.12	-0.62	+0.75	+1.00	+0.50
CJ	+0.50	+0.37	+0.12	0.00	+0.25
KOF	+0.75	+0.25	+0.50	+0.87	+0.62
KOM	+0.75	+0.75	0.00	-0.37	+0.37
KL	+0.50	-0.37	+0.87	+0.87	+0.87
JE	-0.62	+0.37	-1.00	-1.00	-1.00
NE	+1.12	0.00	+1.12	+1.00	+1.25
GK	+0.37	+0.25	+0.25	0.00	+0.50
KL	+0.50	-0.12	+0.62	+0.50	+0.75
JO	-0.12	0.00	-0.12	-0.12	0.00
BH	+0.37	+0.50	-0.12	-0.12	-0.12
SH	+0.12	+0.12	0.00	0.00	-0.25
JD	0.00	+0.37	-0.37	-0.37	-0.12
HB	-0.12	+0.37	-0.50	-0.25	-0.25
BP	+0.37	-0.25	+0.62	+0.62	+0.62
TH	+0.37	-0.12	+0.50	+0.50	+0.75
MG	+0.25	0.00	+0.25	+0.25	+0.50
SK	+0.62	+0.25	+0.37	+0.37	+0.37
SH	+0.25	+0.75	-0.50	-0.50	-0.75
JW	+0.50	+0.62	-0.12	-0.12	+0.12
JF	+0.62	+0.75	-0.12	-0.12	+0.12
RH	+0.25	+0.25	+0.50	+0.50	+0.50
IH	+0.12	0.00	+0.12	+0.12	+0.37
BR	+0.62	+0.62	0.00	0.00	0.00
GC	+0.25	+0.12	+0.12	+0.12	-0.37
KK	-0.25	+0.62	-0.87	-0.87	-0.37
LC	+0.50	+0.62	-0.12	-0.12	-0.12
DC	+0.25	+1.37	-0.12	-0.12	-0.12
TM	+0.50	+1.12	-0.62	-0.62	-0.62

Subject	RG - 14B	RG - 2	2 - 14B	HN - 14B	LN - 14B
LN	+0.25	+0.87	+0.37	+0.37	+0.62
RM	+0.87	+1.12	-0.25	-0.37	-0.12
DM	+0.37	+0.50	-0.12	-0.37	+0.12
BG	+0.50	+0.25	+0.12	+0.37	+0.12
JH	+0.25	+0.12	+0.37	+0.50	+0.12
LH	-0.25	+0.62	-0.87	-0.87	-0.87
DD	+0.75	+0.50	+0.25	+0.37	+0.12
HI	-0.12	-0.62	+0.50	+0.62	+0.37
BB	+0.87	+0.62	+0.25	+0.50	0.00
GB	+0.37	+0.25	+0.12	+0.12	+0.12
AD	+0.75	+0.50	+0.25	+0.25	+0.25
GD	-0.25	-0.12	-0.12	-0.12	-0.12
MWM	-0.12	-0.62	-0.50	+0.25	+0.75
GK	0.00	-0.37	+0.37	+0.37	+0.37
MH	+0.25	+0.37	-0.12	-0.12	-0.12
MM	+0.75	+0.25	+0.50	+0.50	+0.50
JT	+0.12	0.00	+0.12	0.00	+0.25
BF	0.00	+0.75	-0.75	-0.87	-0.62
DTM	+0.12	-0.62	+0.75	+0.75	+0.75
DTF	+0.37	-0.62	+1.00	+0.37	+1.12
RD	0.00	+0.50	-0.50	-0.50	-0.50
JK	0.00	+0.37	-0.37	-0.37	-0.37
EH	+0.37	0.00	+0.37	+1.25	+1.00
AO	+0.62	-0.25	+0.87	+1.25	+1.00
RP	+1.00	+0.12	+0.87	+0.62	+0.12
DF	-0.25	-0.12	-0.12	-0.25	-0.25
MWF	+0.37	0.00	+0.37	0.00	+0.25

Parametric Analysis of Near Test Relationships

A repeated measure design was run on the data for the total of 57 subjects. See Table #7 for the raw data on the lags for the three near tests compared. From this analysis we found that the tests are significantly different at the 0.01 level of confidence and there is no significant difference between subject variance on the three tests at the 0.01 level of confidence.

A linear regression and Pearson's correlation were run on the data also. The relationships as found by the linear regression allows one to predict one near point finding on the basis of another. The relative accuracy of these predictions is indicated by Pearson's "r" correlation. Although the correlations indicated that the accommodative response is not the same under the three testing conditions, since these figures ranged from 0.518 to 0.541 level of correlation, there is a positive relationship between the three near tests.

The details of these computations can be found in the appendix on pages 57-61.

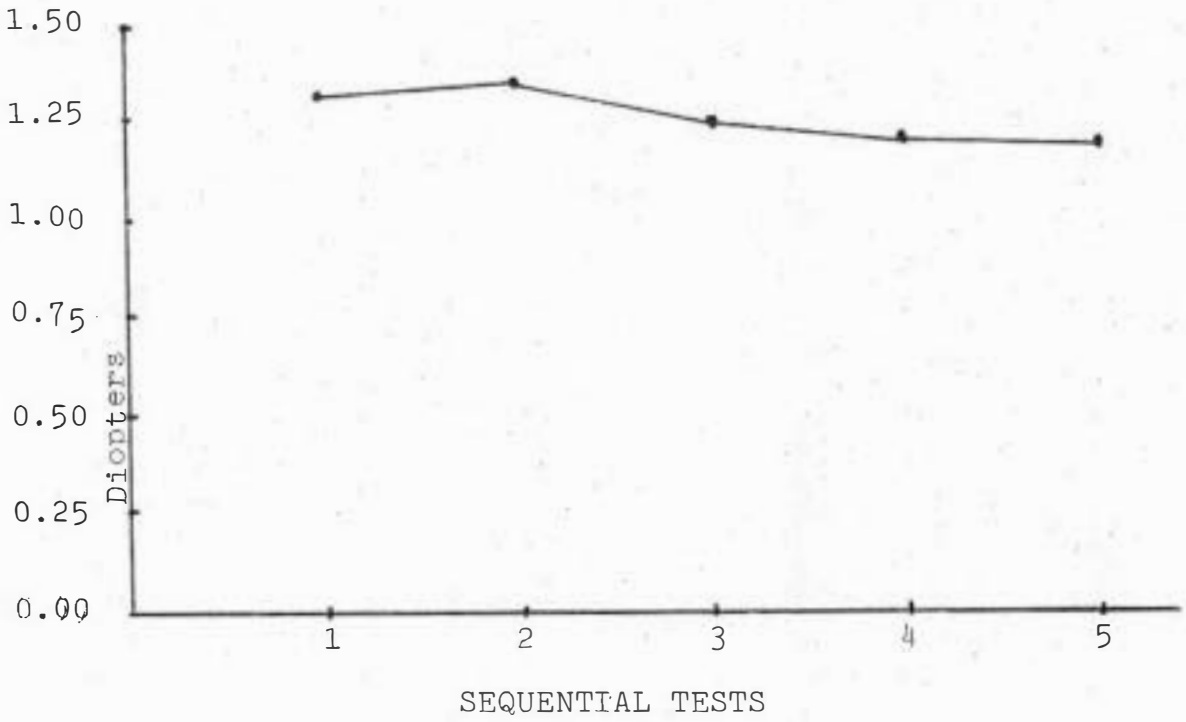
Change Over Time of Near Red-Green Test

The response over time to the Near Red-Green test was evaluated using the same twenty subjects used for the repeatability study. Lags were computed in the same chronological order in which they were taken, i.e. those taken first in the testing sequence were averaged together, those taken second were averaged together, etc. The algebraic difference between the means showing the greatest and smallest lags was only 0.08D showing no trend toward greater plus or minus. The lags and standard deviations are shown in Graph #3. The average accommodative lags with sequential tests are shown in Graph #4, page 51.

Graph #3

DIFFERENCE IN MEAN VALUES OF NEAR RED-GREEN TESTS

OVER TIME, ON TWENTY SUBJECTS.

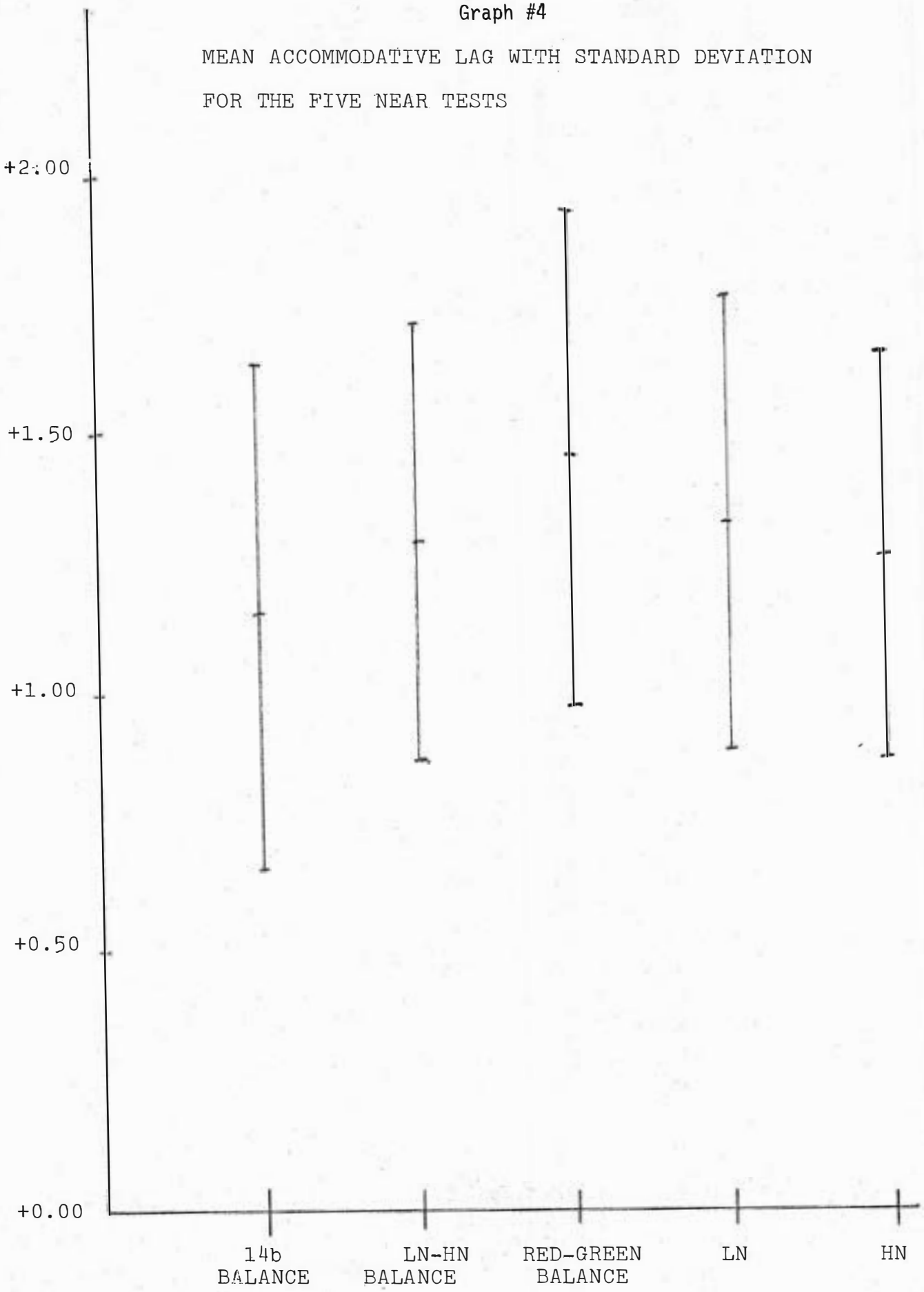


Graph #3 shows the distribution of the mean value for the twenty subjects used in the Red-Green repeatability study with successive measurements.

Graph #4

MEAN ACCOMMODATIVE LAG WITH STANDARD DEVIATION

FOR THE FIVE NEAR TESTS



Conclusions

1. We found a high reliability among the results taken by the three different clinicians both on the "P" values and on the Vodnoy Near Red-Green test values.
2. We found a high repeatability of the Vodnoy Near Red-Green test with no trend toward greater or less plus over time as measured in our experimental sequence.
3. We found a definite difference between the subjects responses on the three near tests, HN-LN balance, near cross cylinder test (14B) balance, and near red-green balance. The variance of the subject responses on the three near tests were almost equal.
4. The non-parametric analysis of the data shows the basic relationship between the five near point tests. The Red-Green near point test was the highest in plus, followed by the Low Neutral Retinoscopy, the High-Low Neutral Retinoscopy balance, the High Neutral Retinoscopy, and finally the Near Cross Cylinder balance (14B) findings. The same results were found in the parametric analysis of the data. The calculated variability of the linear regression indicates that the several tests are related but different tests and can not be freely substituted clinically without due consideration.

Summary

The Vodnoy #533A Red-Green Near Point Test proved to be a highly reliable measure of the accommodative response, that is, repeatable on a test - retest basis.

We feel that the prognostic value of the Red-Green near point test at the present time is somewhat limited. However, since the test is highly repeatable, a truer correction factor for converting the Near Red-Green finding may be found with further testing.

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10. Haynes, H. M.

11. Pratt, C.

APPENDIX

Table of Contents

Parametric Analysis

"P" Values

I. Repeated Measures Design

1. $\frac{G^2}{KN} = \frac{13.62^2}{(3)(5)} = \frac{185.50}{15} = 12.37$

2. $\sum_{i=1}^{K=3} \sum_{i=1}^{N=5} X^2 = 19.68 + 20.56 + 21.21 = 61.45$

3. $\frac{\sum T^2_i}{N} = \frac{4.86^2 + 4.25^2 + 4.49^2}{5} = 12.37$

4. $\frac{\sum P^2_i}{K} = \frac{.25^2 + 1.75^2 + 13.37^2 + .50^2 + 1.25^2}{3} = 61.17$

Sources of Variation and Sums of Squares:

1. SS between persons = (4) - (1) = 61.17 - 12.37 = 48.80

2. SS within persons = (2) - (4) = 61.45 - 61.17 = 0.28

3. SS clinicians = (3) - (1) = 12.37 - 12.37 = 0.00

4. SS error = (2) - (3) - (4) + (1) = 61.45 - 12.37 - 61.17 + 12.37
= 0.279

5. SS total = (2) - (1) = 61.45 - 12.37 = 49.08

BETWEEN CLINICIANS:

$F_{obs} = \frac{\text{MS clinicians}}{\text{MS error}} = \frac{0.0005}{4.090} = 0.0012$

degrees of freedom = (2,8)

Critical Value for $F_{.99}$ (2,8) = 8.65

Parametric Analysis

Three near tests

I. Repeated Measures Design:

SUBJECT	14B - P	$\frac{HN-LN}{2}$ - P	RG - P	TOTAL
N = 57	T_1 = 65.89	T_2 = 75.62	T_3 = 85.35	G = 226.86
	$\sum X^2$ = 89.73	$\sum X^2$ = 104.40	$\sum X^2$ = 146.60	

1. $\frac{G^2}{KN} = \frac{(226.86)^2}{(3)(57)} = 300.97$ K = Number of Tests

2. $\sum_{i=1}^{K=3} \sum_{i=1}^{N=57} X^2 = 89.73 + 104.40 + 146.60 = 340.74$

3. $\frac{\sum T^2_i}{N} = \frac{65.89^2 + 75.62^2 + 85.35^2}{57} = 304.29$

4. $\frac{\sum P^2_i}{K} = \frac{P_1^2 + P_2^2 + P_3^2 + \ldots\ldots P_{57}^2}{3} = \frac{935.30}{3} = 311.76$

Sources of Variation and Sums of Squares:

1. SS between persons = (4) - (1) = 311.76 - 300.97 = 10.79
2. SS within persons = (2) - (4) = 340.74 - 311.76 = 28.98
3. SS Accommodative posture tests = (3) - (1)
   = 304.29 - 300.97 = 3.32
4. SS error = (2) - (3) - (4) + (1)
   = 340.74 - 304.29 - 311.76 + 300.97 = 24.96
5. SS total = (2) - (1) = 340.74 - 300.97 = 39.77

Summary Table for ANOV (correlated measures)

Source of Variation	SS	df	MS
Between people	10.79	N-1 = 56	$\frac{10.79}{56} = .192$
Within persons	28.98	(K-1)N = 114	
Accom. Posture Tests	3.32	K - 1 = 2	$\frac{3.32}{2} = 1.66$
Error	24.96	(N-1)(K-1) = 112	$\frac{24.96}{112} = .223$
Total	39.77	KN - 1 = 170	

BETWEEN TESTS:

$$F_{obs} = \frac{\text{MS tests}}{\text{MS error}} = \frac{1.66}{.223} = 7.45$$

degrees of freedom = (2, 112)

Critical value for $F_{.95}$ (2,112) = 4.796

BETWEEN PEOPLE:

$$F_{obs} = \frac{\text{MS people}}{\text{MS error}} = \frac{0.192}{0.223} = 0.8644$$

degrees of freedom = (56,112)

Critical value for $F_{.95}$ (56,112) = 1.704

II. Linear Regression

Measures of variability for the three tests:

1. $SS_x = \sum_{i=1}^{N} X^2_i - \frac{(\sum Xi)^2}{N}$

$$SS_{RG} = 146.60 - \frac{(83.35)^2}{57} = 24.72$$

$$SS_{Ret} = 104.40 - \frac{(75.62)^2}{57} = 4.08$$

$$SS_{14B} = 89.74 - \frac{(65.89)^2}{57} = 13.57$$

2. $S^2_x = \frac{SSx}{N - 1}$

$S^2_{RG} = \frac{24.72}{57} = 0.441$

$S^2_{Ret} = \frac{4.08}{57} = 0.073$

$S^2_{14B} = \frac{13.57}{57} = 0.242$

3. $S_x = \sqrt{S^2_x}$

$S_{RG} = 0.664$

$S_{Ret} = 0.270$

$S_{14B} = 0.497$

Correlation between tests:

1. $SS_{xy} = \sum_{i=1}^{N} xiyi - \frac{(\sum_{i=1}^{N} xi)(\sum_{i=1}^{N} yi)}{N}$

$SS_{14B - RG} = 105.83 - \frac{(65.89)(83.35)}{57} = 9.48$

$SS_{Ret - RG} = 116.00 - \frac{(75.62)(83.35)}{57} = 5.43$

$SS_{Ret - 14B} = 91.31 - \frac{(65.89)(75.62)}{57} = 3.90$

2. Slope $= \hat{B}_1 = \frac{SSxy}{SSx}$

Y intercept $= \hat{B}_o = \bar{y} - \hat{B}_1 \bar{x}$: $\hat{y} = \hat{B}_o + \hat{B}_1 x$

1. RG = y, 14B = x

Slope $= \frac{9.48}{13.59} = 0.699$

Y intercept $= 1.46 - 0.699(1.16) = 0.655$

$\hat{y} = 0.655 + 0.699x$

14B = Y, RG = x

Slope $= \frac{9.48}{24.72} = 0.384$

Y intercept $= 1.16 - 0.384(1.46) = 0.594$

$\hat{y} = 0.594 + 0.384x$

Best Fit $= \hat{y} = 0.624 + 0.541\ x$

2. RG = y
   Ret = x

   Slope = $\frac{5.43}{4.08} = 1.331$

   Y intercept = 1.46 - 1-33(1.32) = -.303

   $\hat{y} = -.303 + 1.331x$

   Ret = y
   RG = x

   Slope = $\frac{5.43}{24.72} = 0.219$

   Y intercept = 1.32 - 0.219(1.46) = 1.00

   $\hat{y} = 1.00 + 0.219x$

   Best Fit = $\hat{y} = 0.351 + 0.176x$

3. 14B = y
   Ret = x

   Slope = $\frac{3.90}{4.08} = 0.955$

   Y intercept = 1.16 - 0.955(1.32) = 0.01

   $\hat{y} = 0.01 + 0.955x$

   Ret = y
   14B = x

   Slope = $\frac{3.90}{13.59} = 0.287$

   Y intercept = 1.32 - 0.287(1.16) = 0.995

   $\hat{y} = 0.995 + 0.287x$

   Best Fit = $\hat{y} = 0.503 + 0.621x$

III. Standard Error of Estimate

1. $SEE = \sum_{i=1}^{N} (yi - \hat{y}i)^2 = SSy - \frac{(SSxy)^2}{SSx}$

$SEE_{14B - RG} = 24.72 - \frac{(9.48)^2}{13.57} = 18.08$

$SEE_{Ret - RG} = 24.72 - \frac{(5.43)^2}{4.08} = 17.49$

$SEE_{Ret - 14B} = 4.08 - \frac{(3.90)^2}{13.58} = 2.96$

2. $S^2 = \frac{SEE}{N - 2}$

$S^2_{14B - RG} = \frac{18.08}{55} = 0.329$ $\quad S = 0.574$

$S^2_{Ret - RG} = \frac{17.49}{55} = 0.318$ $\quad = 0.564$

$S^2_{Ret - 14B} = \frac{2.96}{55} = 0.054$ $\quad = 0.232$

IV. Pearson's R

$$R = \frac{\sum_{i=1}^{N} (xi - \bar{x})(yi - \bar{y})}{\sqrt{\sum_{i=1}^{N} (xi-\bar{x})^2 \sum_{i=1}^{N} (yi-\bar{y})^2}} = \frac{SSxy}{\sqrt{SSxSSy}}$$

$R_{14B - RG} = \frac{9.48}{\sqrt{(13.59)(24.72)}} = 0.518$ $\quad R^2 = 0.268$

$R_{Ret - RG} = \frac{5.43}{\sqrt{(4.08)(24.72)}} = 0.541$ $\quad = 0.292$

$R_{Ret - 14B} = \frac{3.90}{\sqrt{(13.59)(4.08)}} = 0.524$ $\quad = 0.274$

Raw Data Collected From 57 Subjects

The following twenty-seven pages display the raw data collected from all 57 subjects.

AGE	29	29	32	31	16
EXAMINER	O'Connell	O'Connell	O'Connell	O'Connell	O'Connell
#1 OD	41.50/40.50 @ 90	42.25/43.25 @ 90	41.25/41.75 @ 90	44.50/46.50 @ 90	45.50/46.50@ 90
OS	41.00/40.75 @ 90	42.25/42.50 @ 90	41.50/42.00 @ 90	44.00/47.00 @ 90	45.00/47.00@ 90
#4 OD	+0.25 -1.00 X 90	-0.75 -0.25 X180	plano	+1.00 -1.00X 180	+1.75 -1.00X180
OS	+0.25 -0.75 X 90	-1.25 -0.25 X180	+0.25 -0.25X180	+1.50 -2.00X 180	+1.25 -1.00X180
JCC OD	+0.25 -1.00 X 95	-0.75 -0.50 X110	plano	+0.50 -0.75X 180	+1.75 -0.75X180
OS	+0.25 -0.75 X 85	-0.75 -0.75 X 80	plano -0.25X1.50	+1.25 -0.75X 180	+1.25 -0.75X180
Jcc OD	-0.25 wc	-1.25 wc	plano	+0.50 wc	+1.25 wc
Mon+ OS	plano wc	-1.25 wc	+0.25 wc	+0.25 wc	+1.25 wc
Mon- OD	plano wc	-1.25 wc	+0.25	+0.50 wc	+1.50 wc
OS	+0.25 wc	-1.50 wc	+0.50 wc	+0.50 wc	+1.50 wc
OD	-0.25 wc	-1.25 wc	plano	+0.50 wc	+1.25 wc
Bino+ OS	plano wc	-1.50 wc	+0.25 wc	+0.50 wc	+1.25 wc
Bino- OD	plano wc	-1.00 wc	plano	+0.75 wc	+1.50 wc
OS	+0.25 wc	-1.25 wc	+0.25 wc	+0.75 wc	+1.50 wc
7 RG OD	plano wc	-1.00 wc	plano	+0.50 wc	+1.00 wc
Mon+ OS	plano wc	-1.25 wc	+0.25 wc	+0.50 wc	+1.00 wc
Mon- OD	+0.25 wc	-0.75 wc	plano	+0.50 wc	+1.25 wc
OS	+0.25 wc	-0.75 wc	+0.25 wc	+0.75 wc	+1.25 wc
OD	plano wc	-1.25 wc	-0.75	+0.25 wc	+1.25 wc
Bino+ OS	plano wc	-1.25 wc	-0.50 wc	+0.50 wc	+1.25 wc
Bino- OD	+0.25 wc	-0.75 wc	-0.50	+0.50 wc	+1.25 wc
OS	+0.25 wc	-0.75 wc	-0.25 wc	+0.75 wc	+1.25 wc
'7 Mon OD	+0.50 wc	-0.25 wc	+0.50	+1.25 wc	+2.00 wc
OS	+0.75 wc	-0.50 wc	+0.75 wc	+1.25 wc	+2.00 wc
Bino OD	+0.50 wc	-0.25 wc	+0.50	+1.25 wc	+2.00 wc
OS	+0.75 wc	-0.50 wc	+0.75 wc	+1.25 wc	+2.00 wc
'a Bino OD	plano wc	-0.75 wc	+0.25	+0.75 wc	+1.50 wc
OS	+0.25 wc	-1.00 wc	+0.50 wc	+0.75 wc	+1.50 wc
P OD	+0.12 wc	-0.87 wc	plano	+0.75 wc	+1.50 wc
OS	+0.12 wc	-0.87 wc	+0.12 wc	+1.00 wc	+1.50 wc

'IN	OD	+1.00	+1.00	+1.50	+2.25	+2.75
	OS	+1.00	+0.50	+1.75	+2.25	+2.75
.N	OD	+1.00	+0.50	+1.75	+2.50	+3.50
	OS	+1.00	plano	+2.00	+2.50	+3.50
14A +	OD	+1.75	+0.50	+1.75	+2.50	+4.00
	OS	+2.00	+0.25	+2.00	+2.25	+4.00
-	OD	+1.75	+0.50	+1.75	+2.50	+4.00
	OS	+2.00	+0.25	+2.25	+2.25	+4.00
14B +	OD	+1.00	plano	+1.50	+1.75	+3.00
	OS	+1.00	-0.25	+1.75	+1.50	+3.00
-	OD	+1.25	plano	+1.50	+2.00	+3.25
	OS	+1.25	-0.25	+1.75	+1.75	+3.25
RG Mon+	OD	+2.25	+0.75	+2.50	+2.75	+3.50
	OS	+2.25	+1.00	+2.75	+3.25	+3.75
Mon-	OD	+2.50	+0.50	+2.75	+3.00	+3.50
	OS	+2.50	+0.75	+2.75	+3.50	+4.00
Bino+	OD	+1.50	-0.25	+2.25	+2.50	+3.75
	OS	+1.50	-0.50	+2.25	+3.00	+4.00
Bino-	OD	+1.75	+0.50	+2.00	+2.75	+4.00
	OS	+1.75	+0.25	+2.00	+3.25	+4.25
20	OD	-1.75	-4.50	-3.50	-2.00	-2.50
	OS	-1.75	-4.75	-3.25	-2.25	-2.50
21	OD	+2.50	+1.25	+3.75	+3.00	+4.25
	OS	+2.50	+1.00	+3.25	+3.25	+4.50

AGE	17	25	30	30	22
EXAMINER	O'Connell	O'Connell	O'Connell	O'Connell	O'Connell
2 OD	44.50/44.50 @ 90	42.25/42.00 @ 90	43.50/43.12 @ 90	42.50/46.25 @ 90	45.00/46.00@ 90
OS	44.50/44.50 @ 90	41.50/42.50 @ 70	43.12/43.12 @ 90	42.25/46.25 @ 75	42.25/46.00@ 90
4— OD	plano	-2.25 -1.00 X 90	+0.50 -1.25 X 90	-0.25 =1.50 X 90	plano
OS	plano	-1.00 sph	+0.50 -1.00 X 90	-0.25 -2.00 X 75	-1.00 sph
CC OD	plano	-2.25 -1.00 X 90	+0.50 -1.75 X 90	-0.25 -1.25 X 90	plano -0.25 X35
OS	plano	plano	+0.50 -1.00 X 90	-0.25 -1.50 X 83	-1.00 sph
CC OD	plano	-2.75 wc	-0.50 wc	-0.25 wc	-1.50 wc
Mon+ OS	plano	-1.25	-0.50 wc	-0.25 wc	-1.50
M n- OD	+0.50	-2.50 wc	plano	-0.25 wc	-0.25 wc
OS	+0.50	-1.00	+0.25 wc	+0.25 wc	-0.50
OD	plano	-2.50 wc	-0.25 wc	-1.25 wc	-1.75 wc
Bino+ OS	plano	-1.00	plano wc	-0.75 wc	-1.50
Bino- OD	+0.25	-2.50 wc	-0.25 wc	-1.50 wc	-0.75 wc
OS	+0.25	-1.00	plano wc	-1.00 wc	-0.50
RG OD	+0.50	-2.50 wc	-0.25 wc	-0.75 wc	-0.25 wc
M n+ OS	+0.25	-1.25	-0.25 wc	-0.50 wc	-0.25
Mon- OD	+0.50	-2.25 wc	plano wc	-0.50 wc	+0.25 wc
OS	+0.50	-1.00	plano wc	-1.50 wc	+0.25
OD	+0.50	-2.50 wc	plano wc	-0.50 wc	plano wc
Bino+ OS	+0.50	-1.25	plano wc	-0.50 wc	plano
Bino- OD	+0.75	-2.25 wc	-0.25 wc	+0.25 wc	+0.25 wc
OS	+0.75	-1.00	-0.25 wc	-0.25 wc	+0.25
Mon OD	+1.00	-2.00 wc	+1.00 wc	+0.75 wc	+0.25 wc
OS	+1.00	-0.50	+1.00 wc	+1.00 wc	plano
Bino OD	+1.00	-2.00 wc	+1.00 wc	+0.75 wc	+0.25 wc
OS	+1.00	-0.50	+1.00 wc	+1.00 wc	plano
Bino OD	plano	-2.50 wc	+0.50 wc	+0.50 wc	plano wc
OS	plano	-1.00	+0.50 wc	+0.25 wc	-0.25
OD	+0.25	-2.37 wc	+0.25 wc	-0.12 wc	-0.25 wc
OS	+0.25	-0.75	+0.50 wc	-0.25 wc	-0.37 65.

—HN	OD	+1.75	-1.00	+1.75	+1.25	+1.50
	OS	+1.75	+0.50	+1.75	+1.50	+1.25
—_N	OD	+1.75	-1.00	+2.00	+1.75	+1.75
	OS	+1.75	-0.50	+2.00	+2.00	+1.50
=nc—						
4A +	OD	+1.75	-0.25	+1.25	+1.25	+1.50
-	OS	+1.75	+0.25	+1.25	+1.00	+1.25
—RC—						
-	OD	+2.00	-0.25	+1.50	+1.25	+1.75
	OS	+2.00	+1.25	+1.50	+1.00	+1.50
4? +	OD	+0.75	+1.00	+0.75	+1.25	+0.75
—	OS	+0.75	+0.50	+0.75	+1.00	+0.50
-	OD	+1.00	-1.00	+0.75	+1.25	+1.25
—in—						
	OS	+1.00	+0.50	+0.75	+1.00	+1.00
RG Mon+	OD	+2.25	-0.25	+2.50	+0.50	+1.50
	OS	+2.00	+1.25	+2.50	+0.25	+1.75
— M —						
Mon-	OD	+2.25	plano	+2.50	+1.00	+2.00
	OS	+2.50	+1.50	+2.50	+0.50	+2.25
—Bi						
Bino+	OD	+1.25	-0.75	+1.75	+1.50	+1.25
—	OS	+1.25	+0.75	+1.75	+1.00	+1.50
Bino-	OD	+1.50	-0.50	+2.00	+1.75	+1.75
	OS	+1.50	+1.00	+2.00	+1.25	+2.00
2(	OD	-3.50	-4.25	-2.25	-3.25	-2.25
	OS	-3.50	-2.75	-2.25	-3.50	-3.00
21	OD	+2.25	+0.50	+3.50	+4.00	+2.50
	OS	+2.50	+2.50	+3.75	+3.75	+2.25

SUBJECT	JO	EH	SH	JD	MB
AGE	27	30	23	26	25
EXAMINER	O'Connell	O'Connell	Keddington	Keddington	Keddington
#: OD	43.00/43.25 @ 90	43.00	44.75/45.00 @ 47	44.50/43.75 @ 80	44.25/45.00@ 90
OS	43.50	43.00/43.25 @ 90	45.50/44.50 @ 47	44.50	44.00/44.25@ 90
#4 OD	-0.50 sph	-0.50 -0.25 X 77	-2.50 -0.75 X140	plano -0.25 X 90	plano sph
OS	plano sph	-1.25 -0.50 X180	-2.50 -0.75 X 90	plano sph	plano sph
JCC OD	no cyl.	-0.50 -0.25 X 77	-2.50 -0.50 X120	plano -0.50 X110	no cyl.
OS	no cyl.	-1.25 -0.50 X180	-2.50 -0.75 X 65	plano -0.25 X 95	no cyl.
7cc OD	-0.25	-1.00 wc	-3.25 wc	-0.50 wc	-0.25
Mon+ OS	-0.25	-1.25 wc	-2.75 wc	-0.50 wc	-0.25
Mon- OD	-0.25	-0.75 wc	-2.75 wc	-0.50 wc	plano
OS	-0.50	-1.50 wc	-2.50 wc	-0.25 wc	plano
OD	-0.50	-1.00 wc	-3.25 wc	-0.50 wc	-0.25
Bino+ OS	-0.75	-1.25 wc	-2.75 wc	-0.50 wc	-0.25
Bino- OD	plano	-0.75 wc	-2.75 wc	-0.50 wc	-0.25
OS	-0.25	-1.50 wc	-2.25 wc	-0.50 wc	-0.25
7 RG OD	-0.25	-0.75 wc	-3.00 wc	plano wc	plano
Mon+ OS	-0.50	-1.50 wc	-2.50 wc	plano wc	plano
Mon- OD	-0.25	-0.50 wc	-2.50 wc	+0.25 wc	+0.25
OS	+0.25	-1.25 wc	-2.25 wc	+0.25 wc	+0.25
OD	-0.25	-1.00 wc	-3.00 wc	plano wc	plano
Bino+ OS	-0.50	-1.25 wc	-2.75 wc	plano wc	plano
Bino- OD	+0.25	-0.25 wc	-2.75 wc	+0.75 wc	+0.25
OS	+0.50	-0.50 wc	-2.50 wc	+0.25 wc	+0.25
7 Mon OD	plano	plano wc	-2.75 wc	+1.00 wc	+0.25
OS	+0.25	-1.25 wc	-2.00 wc	+1.00 wc	+0.25
Bino OD	+0.25	plano wc	-2.50 wc	+1.25 wc	+0.25
OS	+0.50	-1.25 wc	-2.00 wc	+1.25 wc	+0.25
Bino OD	plano	-0.50 wc	-2.75 wc	+0.50 wc	plano
OS	+0.25	-1.75 wc	-2.25 wc	+0.50 wc	plano
OD	-0.12	-0.62 wc	-2.75 wc	+0.25 wc	plano
OS	+0.12	-1.25 wc	-2.25 wc	+0.25 wc	plano

Subject		SD	BH	SH	JD	RB
HN	OD	+1.50	+0.50	-1.50	+1.50	+1.25
	OS	+1.75	-0.25	-1.00	+1.50	+1.25
LN	OD	+1.75	+0.50	-1.75	+1.75	+1.50
	OS	+2.00	-0.25	-1.25	+1.75	+1.50
14A +	OD	+1.50	+1.00	-1.25	+1.75	+2.00
	OS	+2.00	-0.25	-1.75	+1.75	+2.00
-	OD	+1.50	+1.25	-1.00	+2.00	+2.00
	OS	+1.75	+0.25	-1.25	+2.00	+2.00
1[illegible] +	OD	+1.50	+0.50	-0.75	+1.75	+1.75
	OS	+1.75	-0.50	-1.00	+1.75	+1.75
-	OD	+1.75	+0.75	-1.25	+2.00	+1.75
	OS	+2.00	-0.25	-0.50	+2.00	+1.75
RC Mon+	OD	+1.50	+1.50	-1.25	+2.00	+2.00
	OS	+1.50	+1.75	-0.50	+2.00	+1.75
Mon-	OD	+2.25	+0.50	-1.00	+1.75	+2.25
	OS	+2.00	+0.75	-0.25	+2.00	+2.00
Bino+	OD	+1.50	+1.00	-1.50	+2.00	+1.50
	OS	+1.75	plano	-0.75	+2.00	+1.25
ino-	OD	+1.75	+1.00	-1.25	+1.75	+1.75
	OS	+2.00	plano	-0.50	+1.75	+1.50
2(	OD	-2.75	-2.25	-3.00	-1.00	-3.00
	OS	-2.75	-3.50	-4.00	-1.00	-3.00
2	OD	+2.50	+2.25	-0.25	+3.50	+2.25
	OS	+2.75	+1.50	+0.75	+3.75	+2.25

AGE	19	33	9	10	29
EXAMINER	Keddington	Keddington	Keddington	Keddington	Keddington
OD	43.00/43.75 @100	44.50/45.62 @ 90	45.50/47.50 @180	44.50/46.50 @180	45.00
OS	43.37/44.37 @ 66	45.25/45.50 @ 90	45.37/47.00 @180	45.25/46.25 @172	46.62/45.00@ 90
OD	+0.25 -0.25 X155	plano -0.25 X180	+0.25 -0.75 X180	+0.50 -0.25 X180	-2.25 sph
OS	+0.50 -0.25 X135	+0.25 -0.50 X180	plano -0.25 X180	+0.25 -1.25 X165	-2.25 -0.50X180
C OD	+0.25 -0.50 X 20	no cyl.	+0.25 -0.50 X105	+0.50 -0.75 X 15	no cyl.
OS	+0.50 -0.75 X175	+0.25 -0.25 X110	plano -0.25 X 90	+0.75 -0.75 X175	no cyl.
:c OD	-0.25 wc	-0.25	-0.75 wc	+0.25 wc	-2.00
n+ OS	-0.50 wc	-0.25 wc	-0.50 wc	+0.50 wc	-2.50
n- OD	+0.50 wc	plano	-0.50 wc	+0.50 wc	-1.75
OS	+0.25 wc	-0.25 wc	-0.25 wc	+0.75 wc	-2.25
OD	+1.00 wc	+0.25	-0.50 wc	+0.25 wc	-2.00
ino+ OS	+1.00 wc	plano wc	-0.50 wc	+0.25 wc	-2.00
o- OD	+0.75 wc	+0.50	plano wc	+0.50 wc	-2.00
OS	+0.75 wc	+0.25 wc	plano wc	+0.50 wc	-2.00
RG OD	-0.25 wc	-0.25	-0.25 wc	+0.25 wc	-1.75
n+ OS	-0.75 wc	+0.25 wc	-0.25 wc	+0.25 wc	-1.75
Mon- OD	plano wc	plano	-0.75 wc	+0.50 wc	-1.50
OS	-0.50 wc	+0.25 wc	-0.75 wc	+0.50 wc	-1.50
OD	-0.25 wc	plano	-1.00 wc	+0.25 wc	-1.75
Bino+ OS	-0.75 wc	+0.25 wc	-1.00 wc	+0.25 wc	-1.75
o- OD	plano wc	+0.25	-0.75 wc	+1.00 wc	-1.50
OS	-0.50 wc	+0.50 wc	-0.75 wc	+1.00 wc	-1.50
on OD	+1.00 wc	+0.50	+0.75 wc	+0.50 wc	-1.50
OS	+0.75 wc	+0.50 wc	+0.75 wc	+0.50 wc	-1.75
Bino OD	+1.25 wc	+1.00	+0.50 wc	+0.50 wc	-1.50
OS	+1.00 wc	+1.00 wc	+0.50 wc	+0.50 wc	-1.75
a Bino OD	+0.50 wc	+0.25	+0.50 wc	plano wc	-2.00
OS	+1.25 wc	+0.25 wc	+0.50 wc	plano wc	-2.00
P OD	+0.62 wc	+0.25	plano wc	+0.37 wc	-1.87
OS	+0.62 wc	+0.25 wc	plano wc	+0.37 wc	-1.87

5 HN	OD	+1.50	+1.50	+1.50	+1.50	-0.50
	OS	+1.75	+1.25	+1.50	+1.50	-0.50
LN	OD	+1.50	+1.75	+1.75	+1.50	-0.75
	OS	+1.75	+1.50	+1.75	+1.50	-0.75
14A +	OD	+0.50	+1.25	+1.75	+1.25	+0.50
	OS	+0.50	+1.25	+1.75	+1.25	plano
-	OD	+0.75	+1.50	+2.00	+1.50	+0.50
	OS	+0.75	+1.25	+2.00	+1.50	+0.25
14B +	OD	+0.75	+0.75	+1.00	+1.00	plano
	OS	+0.75	+0.50	+1.00	+1.00	-0.25
-	OD	+1.00	+1.25	+1.50	+1.25	plano
	OS	+1.00	+1.00	+1.50	+1.25	-0.25
RC Mon+	OD	+1.00	+2.00	+1.50	+1.50	+0.50
	OS	+1.00	+1.75	+1.75	+1.50	+0.25
Mon-	OD	+0.50	+2.25	+1.75	+1.75	+0.75
	OS	+1.75	+1.75	+2.25	+1.75	+0.50
Bino+	OD	+1.00	+1.25	+1.50	+1.50	+0.25
	OS	+1.00	+0.75	+1.50	+1.50	plano
Bino-	OD	+0.50	+1.50	+1.50	+2.00	+0.25
	OS	+0.50	+1.00	+1.50	+2.00	plano
20	OD	-4.00	-1.25	-3.25	-3.50	-4.00
	OS	-4.00	-1.50	-3.25	-3.50	-4.00
21	OD	+2.00	+2.00	+3.25	+3.25	+0.75
	OS	+2.00	+2.00	+3.25	+3.25	+0.50

SUBJECT	JW	JT	KH	TH	BK
AGE	33	26	33	23	25
EXAMINER	Keddington	Keddington	Keddington	Keddington	Keddington
#2 OD	43.87/45.75 @112	43.37/42.87 @ 75	44.00	43.00/44.00 @ 90	45.50
OS	44.25/44.87 @116	43.75/43.12 @ 75	43.62	42.50/44.00 @ 90	45.00/45.50 @ 90
#4 OD	-0.75	-0.50 -0.50 X 90	+0.50 -0.75 X 90	+0.50 -1.25 X180	+0.50 -0.25 X180
OS	-0.75 -0.75 X 90	plano -1.25 X 90	-0.50 -0.50 X 45	+0.25 -1.50 X180	+0.25 -0.25 X180
JCC OD	-0.75 -0.25 X 90	-0.50 -1.25 X 92	+0.50 -0.75 X105	+0.50 -0.75 X 05	no cyl.
OS	-0.75 -0.75 X 80	plano -2.25 X 90	-0.50 -0.50 X 65	+0.25 -1.00 X170	no cyl.
7cc OD	-0.75 wc	-0.25 wc	-0.50 wc	plano wc	+0.50
Mon+ OS	-0.75 wc	plano wc	-1.00 wc	plano wc	+0.50
Mon- OD	-0.50 wc	plano wc	-0.25 wc	+0.25 wc	+0.75
OS	-0.50 wc	+0.25 wc	-0.75 wc	+0.25 wc	+0.75
OD	-0.75 wc	-0.50 wc	-0.50 wc	plano wc	+0.50
Bino+ OS	-0.75 wc	-0.25 wc	-1.00 wc	plano wc	+0.50
Bino- OD	-0.25 wc	plano wc	-0.25 wc	+0.50 wc	+0.75
OS	-0.25 wc	+0.25 wc	-0.75 wc	+0.50 wc	+0.75
7 RG OD	-0.50 wc	-0.50 wc	-0.25 wc	plano wc	+0.50
Mon+ OS	-0.75 wc	-0.25 wc	-0.75 wc	plano wc	+0.50
Mon- OD	-0.50 wc	-0.25 wc	-0.25 wc	+0.50 wc	+0.75
OS	-0.50 wc	plano wc	-0.50 wc	+0.25 wc	+0.50
OD	-0.50 wc	-0.25 wc	-0.50 wc	+0.25 wc	+0.25
Bino+ OS	-0.50 wc	-0.50 wc	-0.75 wc	+0.25 wc	+0.25
Bino- OD	-0.25 wc	-0.25 wc	plano wc	+0.50 wc	+0.25
OS	-0.25 wc	plano wc	-0.25 wc	+0.50 wc	+0.25
7 Mon OD	+0.50 wc	+0.75 wc	+0.25 wc	+0.50 wc	+1.25
OS	+0.50 wc	+1.00 wc	plano wc	+0.50 wc	+1.25
Bino OD	+0.50 wc	+1.00 wc	+0.25 wc	+0.25 wc	+1.50
OS	+0.50 wc	+1.25 wc	plano wc	+0.25 wc	+1.50
7a Bino OD	-0.25 wc	+0.50 wc	-0.50 wc	+0.25 wc	+1.00
OS	-0.25 wc	+0.25 wc	-0.75 wc	+0.25 wc	+1.00
P OD	-0.37 wc	plano wc	-0.12 wc	+0.50 wc	+0.75
OS	-0.37 wc	+0.25 wc	-0.37 wc	+0.50 wc	+0.75

5 IN	OD	+0.75	+1.25	+1.25	+1.50	+1.75
	OS	+0.75	+1.50	+1.00	+1.50	+1.75
N	OD	+1.00	+1.50	+1.25	+1.75	+1.75
	OS	+1.00	+1.75	+1.00	+1.75	+1.75
14A +	OD	+0.75	+1.50	+1.00	+1.00	+1.75
	OS	+1.00	+1.75	+0.75	+1.00	+2.00
-	OD	+1.00	+2.00	+1.25	+1.50	+2.00
	OS	+1.25	+2.00	+1.50	+1.25	+2.00
14 +	OD	+0.75	+1.25	+0.50	+1.25	+1.50
	OS	+0.75	+1.25	+0.25	+1.25	+1.50
-	OD	+1.00	+1.50	+1.00	+1.50	+2.00
	OS	+1.00	+1.50	+0.75	+1.50	+2.00
RG Mon+	OD	+1.50	+1.75	+1.25	+1.25	+2.50
	OS	+1.50	+2.25	+1.00	+1.25	+2.75
Mon-	OD	+1.75	+2.25	+1.50	+2.00	+2.75
	OS	+1.75	+2.75	+1.00	+2.00	+3.00
Bino+	OD	+1.25	+2.00	+1.00	+1.25	+2.25
	OS	+1.25	+2.50	+0.50	+1.25	+2.25
ino-	OD	+1.50	+2.00	+1.00	+1.75	+2.50
	OS	+1.50	+2.50	+0.50	+1.75	+2.50
20	OD	-1.00	-2.75	-2.25	-2.00	-1.75
	OS	-1.00	-2.75	-2.75	-2.00	-1.75
21	OD	+1.50	+3.00	+2.50	+2.25	+3.75
	OS	+1.75	+3.25	+2.00	+2.25	+3.75

AGE		23	23	24	25	27
EXAMINER		Keddington	Keddington	Keddington	Keddington	Keddington
#2	OD	42.25/43.50 @ 65	43.37/44.00 @ 84	42.50/43.37 @ 78	42.50/43.50 @ 87	42.50
	OS	42.25/44.00 @100	43.50/44.25 @100	42.25/43.62 @ 90	42.75/42.87 @ 78	42.62
#4	OD	-1.75 -1.25 X155	-0.50 -0.25 X180	-3.75	-1.25 -0.50 X 90	-1.00 -0.50X 90
	OS	+0.50 -2.25 X 15	-1.25	-4.25 -0.50 X180	-1.50 -0.50 X 55	-1.00 -0.50X 90
JCC	OD	-1.75 -0.75 X165	-0.50 -0.25 X180	no cyl.	-1.25 -0.75 X115	no cyl.
	OS	+0.50 -2.00 X 15	no cyl.	no cyl.	no cyl.	no cyl.
7cc	OD	-1.50 wc	-1.50 wc	-4.25	-2.00 wc	-1.00
Mon+	OS	+0.25 wc	-2.50	-5.00	-2.75	-1.25
Mon-	OD	-1.25 wc	-1.00 wc	-4.00	-2.00 wc	-0.75
	OS	+0.50 wc	-2.00	-4.75	-2.50	-1.00
	OD	-1.25 wc	-1.00 wc	-4.25	-2.00 wc	-1.00
Bino+	OS	plano wc	-2.00	-5.00	-2.50	-1.25
Bino-	OD	-1.50 wc	-0.75 wc	-4.00	-1.75 wc	-0.75
	OS	+0.25 wc	-1.75	-4.75	-2.75	-1.00
7 RG	OD	-1.50 wc	-1.00 wc	-3.50	-2.25 wc	-0.75
Mon+	OS	+0.25 wc	-2.00	-4.25	-1.75	-1.25
Mon-	OD	-1.00 wc	-0.75 wc	-3.25	-2.25 wc	-0.50
	OS	+0.75 wc	-1.25	-4.00	-1.50	-1.00
	OD	-1.25 wc	-0.75 wc	-3.50	-2.00 wc	-0.75
Bino+	OS	+0.50 wc	-1.75	-4.25	-1.50	-1.25
Bino-	OD	-0.75 wc	-0.50 wc	-3.25	-1.75 wc	-0.50
	OS	+1.00 wc	-1.50	-4.00	-1.25	-1.00
#7 Mon	OD	-1.00 wc	-0.25 wc	-3.25	-2.25 wc	plano
	OS	+0.50	-1.25	-4.25	-1.75	-0.25
Bino	OD	-0.75 wc	plano wc	-3.00	-2.25 wc	+0.25
	OS	+0.75 wc	-1.00	-4.00	-1.75	plano
7a Bino	OD	-1.25 wc	-0.50 wc	-3.25	-2.50 wc	-0.50
	OS	+0.25 wc	-1.50	-4.25	-2.00	-0.75
P	OD	-1.37 wc	-0.50 wc	-3.50	-2.00 wc	-0.62
	OS	+0.50 wc	-1.50	-4.00	-1.50	-0.75

Subject		GC	RK	LC	DC	TM
/5 HN	OD	+0.25	+1.00	-2.25	-0.25	-0.25
	OS	+1.25	+0.25	-3.25	-0.50	-0.25
LN	OD	+0.25	+1.50	-2.25	plano	-0.25
	OS	+1.25	+0.75	-3.25	-0.25	-0.25
14A +	OD	+0.25	+1.75	-2.50	plano	+0.50
	OS	+2.00	+0.50	-2.50	plano	+0.50
-	OD	+0.50	+2.25	-2.25	+0.25	+0.75
	OS	+2.25	+1.00	-2.25	+0.25	+0.75
1[illegible] +	OD	plano	+1.75	-2.25	-0.25	+0.25
	OS	+1.75	+0.50	-2.25	-0.25	+0.25
-	OD	+0.25	+2.00	-2.00	plano	+0.50
	OS	+2.00	+0.75	-2.00	plano	+0.50
RG Mon+	OD	+0.75	+1.75	-1.75	+1.00	+1.25
	OS	+2.75	+0.50	-2.00	+1.00	+1.00
Mon-	OD	+1.00	+2.00	-1.00	+1.25	+1.50
	OS	+3.00	+1.00	-1.50	+1.25	+1.25
Bino+	OD	+0.25	+1.50	-1.75	+1.00	+0.75
	OS	+2.75	+0.50	-2.25	+1.00	+0.50
[illegible]ino-	OD	+0.50	+1.75	-1.50	+1.25	+1.00
	OS	+2.50	+0.75	-2.00	+1.25	+0.75
/2[illegible]	OD	-2.50	-0.25	-9.25	-1.50	-4.50
	OS	-2.00	-0.25	-9.25	-1.50	-4.75
/21	OD	+1.75	+2.25	-1.00	+1.00	+1.75
	OS	+3.50	+1.75	-1.50	+1.00	+1.75

AGE		26	24	24	7	19
EXAMINER		Keddington	O'Connell	Walther	Walther	Walther
#1	OD	43.50/44.00 @ 90	42.50/43.75 @ 90	43.87/45.12 @ 95	47.00/45.50 @ 05	44.25/43.75 @18
	OS	43.50/43.75 @ 90	42.75/43.75 @ 90	43.37/44.75 @ 72	46.75	44.00/43.50 @18
#1	OD	-2.00 -0.25 X140	-3.25 -0.25 X180	+0.50 -0.50 X 90	+0.25 -0.25 X180	plano
	OS	-2.00 -0.25 X180	-3.75	+0.25 -0.25 X 90	+0.50	+0.25
JCC	OD	no cyl.	-3.25 -0.25 X 25	+0.25 -0.50 X 80	no cyl.	+0.50 -0.25X 75
	OS	-2.00 -0.25 X180	no cyl.	+0.25 -0.25 X105	no cyl.	no cyl.
7cc	OD	-2.25	-3.25 wc	-0.25 wc	plano	+0.25 wc
Mon+	OS	-2.00 wc	-3.75	-0.25 wc	+0.25	plano
Mon-	OD	-2.00	-3.00 wc	-0.25 wc	+0.25	+0.50 wc
	OS	-1.75 wc	-3.50	-0.25 wc	+0.25	+0.25
	OD	-2.25	-3.50 wc	-0.25 wc	-0.50	+0.25 wc
Bino+	OS	-2.00 wc	-4.00	-0.25 wc	plano	plano
Bino-	OD	-2.00	-3.25 wc	+0.50 wc	-0.25	+0.25 wc
	OS	-1.75 wc	-3.75	+0.50 wc	+0.25	plano
7 RG	OD	-2.00	-3.25 wc	+0.25 wc	+0.25	+0.25 wc
Mon+	OS	-2.00 wc	-3.75	+0.25 wc	+0.25	+0.25
Mon-	OD	-1.75	-3.75 wc	+0.25 wc	+0.75	+0.50 wc
	OS	-1.75 wc	-3.50	+0.25 wc	+0.50	+0.50
	OD	-2.00	-3.25 wc	+0.25 wc	+0.75	+0.25 wc
Bino+	OS	-2.00 wc	-3.75	+0.25 wc	+0.50	+0.25
Bino-	OD	-1.75	-3.00 wc	plano wc	+0.75	+0.50 wc
	OS	-1.75 wc	-3.50	plano wc	+0.50	+0.50
#7 Mon	OD	-1.50	-3.00 wc	+1.00 wc	+0.50	+1.25 wc
	OS	-1.25 wc	-3.50	+1.00 wc	+0.75	+1.00
Bino	OD	-1.25	-3.00 wc	+1.25 wc	+0.75	+1.00 wc
	OS	-1.00 wc	-3.50	+1.25 wc	+1.00	+1.25
7a Bino	OD	-2.00	-3.25 wc	plano wc	+0.25	+0.25 wc
	OS	-1.75 wc	-3.75	plano wc	+0.50	plano
P	OD	-1.87	-3.25 wc	+0.37 wc	+0.25	+0.37 wc
	OS	-1.62 wc	-3.75	+0.37 wc	+0.50	+0.37

/5	HN	OD	-1.00	-2.50	+1.50	+1.25	+2.00
		OS	-0.75	-3.25	+1.50	+1.25	+2.25
	LN	OD	-0.75	-2.25	+2.00	+1.00	+2.25
		OS	-0.50	-3.00	+2.00	+1.00	+2.00
14A	+	OD	-1.00	-1.75	+1.50	+1.00	+2.50
		OS	-0.50	-2.25	+1.50	+1.00	+2.25
	-	OD	-0.75	-1.50	+1.75	+1.00	+2.50
		OS	-0.25	-2.25	+1.75	+1.00	+2.50
14[illegible]	+	OD	-1.50	-2.25	+1.75	+0.75	+2.00
		OS	-1.25	-3.00	+1.75	+0.75	+2.00
	-	OD	-1.25	-2.00	+2.00	+1.00	+2.00
		OS	-1.00	-2.75	+2.00	+1.00	+2.00
RG	Mon+	OD	plano	-1.00	+1.75	+1.50	+2.75
		OS	+0.25	-1.50	+2.00	+2.25	+2.75
	Mon-	OD	+0.25	-0.75	+2.00	+1.50	+2.75
		OS	+0.50	-1.25	+2.50	+2.25	+2.75
	Bino+	OD	-0.25	-1.50	+1.75	+1.50	+2.25
		OS	plano	-2.00	+2.25	+2.25	+2.25
	[illegible]ino-	OD	plano	-0.75	+2.50	+1.25	+2.25
		OS	+0.25	-1.25	+2.00	+2.00	+2.25
/2(		OD	-6.00	-8.25	-1.50	-4.00	-5.25
		OS	-5.75	-9.00	-1.50	-3.50	-5.25
/21		OD	plano	-0.25	+3.50	+2.50	+3.75
		OS	+0.75	-1.00	+3.50	+2.00	+3.75

SUBJECT		LH	DD	HI	BB	GB
AGE		19	24	25	29	7
EXAMINER		Walther	Walther	Walther	Walther	Walther
#	OD	44.00/43.12 @ 65	43.50/44.50 @ 90	43.00/43.62 @ 90	41.50	40.87/42.12@ 90
	OS	44.00/43.50 @ 05	43.75/45.50 @ 75	43.00/43.62 @ 90	42.00	42.50/42.87@ 90
#4	OD	+0.25 -1.00 X135	+0.50 -0.50 X 180	+0.50 -0.50 X180	-0.25	+0.25
	OS	-0.25	+0.50 -0.50 X 180	+0.50 -0.25 X180	-0.50	+0.50
JCC	OD	plano -0.75 X140	plano -0.25 X 05	+0.50 -0.25 X 10	no cyl.	no cyl.
	OS	-0.25 -0.50 X 30	+0.25 -0.25 X165	+0.50 -0.25 X 13	no cyl.	no cyl.
7 c	OD	plano wc	-0.50 wc	-0.75 wc	-0.75	plano
Mon+	OS	-0.25 wc	-0.50 wc	-0.50 wc	-0.75	-0.25
on-	OD	+0.25 wc	-0.25 wc	-0.25 wc	-0.50	+0.50
	OS	plano wc	-0.50 wc	-0.75 wc	-0.50	+0.25
	OD	plano wc	-0.25 wc	plano wc	-0.75	+0.25
Bino+	OS	-0.25 wc	-0.50 wc	-0.25 wc	-0.75	plano
Bino-	OD	+0.25 wc	plano wc	+0.25 wc	-0.25	+0.50
	OS	plano wc	-0.25 wc	plano wc	-0.25	+0.25
7 RG	OD	-0.50 wc	plano wc	-0.50 wc	-0.50	+0.50
on+	OS	-0.75 wc	-0.25 wc	-0.75 wc	-0.50	+0.25
on-	OD	plano wc	plano wc	-0.75 wc	-0.50	+0.50
	OS	-0.25 wc	-0.25 wc	-0.50 wc	-0.50	+0.25
	OD	-0.25 wc	plano wc	-0.25 wc	-0.50	plano
Bino+	OS	-0.50 wc	-0.25 wc	-0.50 wc	-0.50	plano
Bino-	OD	plano wc	plano wc	-0.50 wc	-0.50	-0.25
	OS	-0.25 wc	-0.25 wc	-0.75 wc	-0.50	-0.25
#7 Mon	OD	+0.75 wc	+0.25 wc	+1.25 wc	+0.25	+0.75
	OS	+0.50 wc	+0.25 wc	+1.25 wc	plano	+0.75
Bino	OD	+0.75 wc	+0.50 wc	+1.50 wc	+0.25	+1.00
	OS	+0.50 wc	+0.50 wc	+1.50 wc	plano	+1.00
7a	ino OD	plano wc	plano wc	+1.25 wc	-0.25	plano
	OS	-0.25 wc	plano wc	+1.25 wc	-0.50	plano
P	OD	+0.12 wc	+0.12 wc	+0.50 wc	-0.25	+0.25
	OS	plano wc	-0.12 wc	+0.50 wc	-0.37	+0.12

5 HN	OD	+1.25	+1.25	+1.50	+1.50	+1.50
	OS	+1.00	+1.25	+1.25	+1.50	+1.50
LN	OD	+1.25	+1.00	+1.25	+1.00	+1.50
	OS	+1.00	+1.00	+1.00	+1.00	+1.50
14A +	OD	+2.25	+1.50	+1.00	+1.50	+2.00
	OS	+1.75	+1.50	+0.75	+1.25	+2.00
-	OD	+2.50	+1.75	+1.00	+2.00	+1.75
	OS	+2.00	+1.75	+1.00	+1.75	+1.75
14B +	OD	+2.00	+0.75	+0.75	+0.75	+1.50
	OS	+1.50	+0.75	+0.50	+0.50	+1.50
-	OD	+2.25	+1.00	+1.00	+1.25	+1.25
	OS	+1.75	+1.00	+0.75	+1.00	+1.25
RG Mon+	OD	+2.25	+2.00	+1.50	+1.75	+2.00
	OS	+1.75	+2.25	+1.75	+1.75	+2.25
Mon-	OD	+2.50	+2.00	+1.75	+2.00	+2.00
	OS	+2.00	+2.25	+1.25	+2.00	+2.25
Bino+	OD	+2.25	+1.25	+1.25	+1.75	+1.50
	OS	+1.75	+1.25	+1.00	+1.75	+1.50
Bino-	OD	+2.50	+1.50	+1.75	+2.00	+2.00
	OS	+2.00	+1.50	+1.00	+2.00	+2.00
20	OD	-2.75	-2.50	-3.00	-1.50	-0.50
	OS	-3.00	-2.75	-3.00	-1.75	-0.75
21	OD	+3.25	+2.50	+3.25	+2.75	+3.50
	OS	+3.00	+2.75	+3.25	+2.50	+3.50

SUBJECT		AD	GD	MW	GK	MH
AGE		11	9	27	25	28
EXAMINER		Walther	Walther	Walther	Walther	Walther
#	OD	42.37/43.75 @ 90	45.50/44.75 @ 90	44.75/45.50 @ 75	42.12/42.87 @ 90	43.25/42.50@ 95
	OS	43.00/44.00 @ 90	44.50/45.00 @ 90	44.75/46.50 @107	42.12/42.00 @ 93	43.62/42.62@ 98
#4	OD	-5.75 -0.50 X180	-0.50 -0.25 X180	-5.50 -0.50 X180	-0.50 -0.50 X105	-0.75 -1.50X 90
	OS	-5.00 -0.50 X180	-0.25 -0.50 X180	-5.50 -0.75 X 15	-0.75 -1.00 X180	-1.00 -1.50X 96
JCC	OD	no cyl.	no cyl.	-5.25 -0.50 X120	-0.50 -0.25 X100	-0.50 -1.00X 90
	OS	no cyl.	-0.25 -0.50 X160	-4.75 -1.00 X 20	-1.00 -0.75 X180	-0.75 -1.25X 93
7 :	OD	-5.50	-0.75	-5.75 wc	-0.75 wc	-1.00 wc
Mon+	OS	-4.75	-0.75 wc	-5.25 wc	-1.75 wc	-1.00 wc
on-	OD	-5.75	-0.75	-5.25 wc	-0.50 wc	-0.75 wc
	OS	-5.00	-0.75 wc	-5.00 wc	-1.50 wc	-1.00 wc
	OD	-5.75	-0.75	-5.50 wc	-1.00 wc	-1.25 wc
Bino+	OS	-4.75	-0.75 wc	-5.25 wc	-2.00 wc	-1.25 wc
Bino-	OD	-5.75	-0.50	-5.25 wc	-0.50 wc	-0.75 wc
	OS	-4.75	-0.50 wc	-4.75 wc	-1.50 wc	-0.75 wc
7 RG	OD	-5.75	-0.50	-5.50 wc	-0.50 wc	-0.75 wc
on+	OS	-4.75	-0.75 wc	-5.00 wc	-1.00 wc	-0.50 wc
on-	OD	-5.75	-0.25	-5.25 wc	-0.50 wc	-0.50 wc
	OS	-4.75	-0.25 wc	-4.75 wc	-1.00 wc	-0.25 wc
	OD	-6.00	-0.50	-5.50 wc	-0.75 wc	-0.75 wc
Bino+	OS	-5.00	-0.25 wc	-5.50 wc	-1.25 wc	-0.50 wc
Bino-	OD	-6.00	plano	-5.25 wc	-0.50 wc	-0.50 wc
	OS	-5.00	+0.25 wc	-4.75 wc	-1.00 wc	-0.25 wc
#7 Mon	OD	-5.00	-0.25	-5.00 wc	-0.25 wc	+0.25 wc
	OS	-4.25	-0.25 wc	-4.50 wc	-0.50 wc	plano wc
Bino	OD	-5.00	plano	-5.00 wc	-0.25 wc	+0.50 wc
	OS	-4.00	plano wc	-4.50 wc	-0.50 wc	+0.25 wc
/a ino	OD	-5.50	-0.75	-5.25 wc	-0.75 wc	-0.25 wc
	OS	-4.50	-0.75 wc	-5.00 wc	-1.00 wc	-0.50 wc
P	OD	-5.62	-0.50	-5.37 wc	-0.62 wc	-0.50 wc
	OS	-4.62	-0.50 wc	-5.00 wc	-1.00 wc	-0.37 wc

		AD	GD	HW	GR	
5 IN	OD	-4.25	+0.75	-3.75	+1.50	+0.50
	OS	-3.25	+0.75	-3.50	+1.25	+0.75
.N	OD	-4.25	+0.75	-3.25	+1.50	+0.50
	OS	-3.25	+0.75	-2.75	+1.25	+0.75
14A +	OD	-4.25	+0.25	-3.25	+1.00	+0.75
	OS	-3.25	+0.50	-3.25	+0.75	+1.00
-	OD	-3.50	+0.75	-3.50	+1.00	+1.00
	OS	-4.00	+0.75	-3.25	+0.75	+1.00
14 +	OD	-4.50	+0.50	-4.00	+1.25	+0.75
	OS	-3.50	+0.50	-3.75	+1.00	+0.75
-	OD	-4.50	+1.25	-4.00	+1.00	+0.50
	OS	-3.50	+1.25	-3.25	+0.75	+0.50
RG Mon+	OD	-3.25	+0.75	-4.25	+1.50	+1.25
	OS	-2.25	+1.00	-3.75	+0.75	+1.25
Mon-	OD	-3.00	+1.00	-3.50	+1.50	+1.50
	OS	-2.00	+1.25	-3.25	+0.75	+1.50
Bino+	OD	-3.75	+0.50	-4.25	+1.00	+0.75
	OS	-2.75	+0.75	-3.75	+0.25	+0.75
ino-	OD	-3.75	+0.75	-4.00	+1.25	+1.00
	OS	-2.75	+1.00	-3.00	+0.50	+1.00
20	OD	-7.75	-1.00	-5.75	-2.50	-2.75
	OS	-7.50	-0.75	-5.25	-2.75	-2.50
21	OD	+2.00	+2.00	-3.00	+2.50	+2.75
	OS	+1.50	+2.25	-2.00	+2.75	+2.50

SUBJECT		MM	JT	BF	DTM	DTF
AGE		16	6	25	30	30
EXAMINER		Walther	Walther	Walther	Walther	Walther
#2	OD	43.50/44.50 @120	43.00/44.37 @ 90	41.12	41.62/42.75 @100	44.75
	OS	43.75/44.50 @ 70	43.00/43.75 @ 90	41.75/42.00 @ 89	41.37/42.37 @ 90	44.75
#4	OD	+0.50 -0.50 X 30	+0.25	-0.50	+0.25 -0.75 X180	-4.50 -1.25X15
	OS	+0.25 -0.50 X180	+0.25	-0.25	+0.50 -0.50 X180	-4.25 -0.75X18
JCC	OD	+0.75 -0.50 X 70	no cyl.	no cyl.	+0.25 -0.75 X180	-5.25 -0.50X15
	OS	+0.50 -0.25 X 90	no cyl.	no cyl.	+0.50 -0.50 X180	-5.75 -1.00X16
cc	OD	plano wc	+0.50	-0.75	plano wc	-5.75 wc
Mon+	OS	plano wc	+0.25	-0.50	plano wc	-4.75 wc
Mon-	OD	plano wc	+0.75	-0.25	plano wc	-5.75 wc
	OS	-0.25 wc	+0.75	plano	plano wc	-4.50 wc
	OD	+0.25 wc	plano	-0.50	+0.50 wc	-4.75 wc
Bino+	OS	+0.25 wc	plano	-0.25	plano wc	-3.75 wc
Bino-	OD	+0.25 wc	+0.50	-0.25	+0.75 wc	-4.50 wc
	OS	+0.25 wc	+0.50	plano	+0.25 wc	-3.50 wc
7 RG	OD	+0.25 wc	+0.50	-1.00	-1.00 wc	-4.75 wc
Mon+	OS	+0.25 wc	+0.50	-1.00	-0.50 wc	-5.25 wc
Mon-	OD	+0.50 wc	+0.75	-0.75	-1.00 wc	-4.75 wc
	OS	+0.25 wc	+0.75	-0.75	-0.50 wc	-5.25 wc
	OD	+0.75 wc	+0.50	-0.75	-0.50 wc	-5.50 wc
Bino+	OS	+0.50 wc	+0.50	-0.75	plano wc	-6.00 wc
Bino-	OD	+0.75 wc	+0.75	-0.50	-0.25 wc	-5.25 wc
	OS	+0.50 wc	+0.75	-0.50	+0.25 wc	-5.75 wc
#7 Mon	OD	+1.25 wc	+1.25	+0.25	+0.75 wc	-4.00 wc
	OS	+1.00 wc	+1.25	+0.50	+1.25 wc	-2.25 wc
Bino	OD	+1.75 wc	+1.25	+0.25	+0.75 wc	-3.75 wc
	OS	+1.50 wc	+1.25	+0.50	+1.25 wc	-2.00 wc
#7 Bino	OD	+0.50 wc	+0.75	-0.25	-0.25 wc	-4.50 wc
	OS	+0.25 wc	+0.75	plano	+0.25 wc	-2.75 wc
	OD	+0.75 wc	+0.62	-0.37	-0.12 wc	-4.50 wc
	OS	+0.50 wc	+0.62	plano	+0.50 wc	-3.62 wc

SUBJECT		MM	JT	BF	DTM	DTF
#1 HN	OD	+2.00	+2.00	+0.25	+1.75	-3.00
	OS	+1.75	+2.00	+0.50	+1.50	+1.25
LN	OD	+2.00	+2.25	+0.50	+1.75	-2.75
	OS	+1.75	+2.25	+0.75	+1.50	+1.00
14A +	OD	+1.75	+3.00	+1.25	+1.75	-3.25
	OS	+1.50	+3.00	+1.50	+1.50	-1.50
-	OD	+1.75	+3.50	+1.50	+2.00	-3.25
	OS	+1.25	+3.50	+1.75	+1.75	-1.50
B +	OD	+1.50	+2.75	+1.00	+1.00	-4.00
	OS	+1.25	+2.75	+1.00	+0.75	-2.25
-	OD	+1.50	+3.25	+1.25	+1.00	-3.25
	OS	+1.25	+3.25	+1.25	+0.75	-2.00
Mon+	OD	+2.25	+2.25	+1.50	+1.25	-3.75
	OS	+1.75	+2.50	+1.50	+1.25	-1.25
Mon-	OD	+2.50	+2.50	+1.50	+1.50	-3.75
	OS	+1.50	+2.75	+1.75	+1.25	-1.00
Bino+	OD	+2.00	+2.00	+1.00	+1.00	-3.50
	OS	+1.00	+2.25	+1.25	+1.00	-1.75
Bino-	OD	+2.50	+2.25	+1.25	+1.00	-3.50
	OS	+1.50	+2.00	+1.50	+1.00	-1.75
#2 R	OD	-6.75	-3.50	-3.50	-1.25	-6.50
	OS	-7.00	-3.50	-3.25	-0.50	-5.00
#2 R	OD	+3.25	+3.00	+2.25	+2.25	-1.25
	OS	+3.00	+3.25	+2.50	+3.00	+0.25

AGE	30	22	25	25	25
EXAMINER	Keddington	O'Connell	Walther	O'Connell	Keddington
# OD	44.00/45.00 @ 98	43.50/45.25 @ 90	43.00/43.87 @ 90	43.50/43.87 @ 90	43.62/43.87@ 9(
OS	44.25/45.50 @ 98	43.25/44.50 @ 90	43.00/43.87 @ 85	43.25/43.87 @ 90	43.25/43.87@ 9(
#- OD	-1.50 -0.25 X 15	+0.50 -0.50 X180	-0.50 -0.25 X140	-0.50	-0.75
OS	-1.75	+0.25 -0.50 X180	-0.25 -0.25 X180	-0.25	-0.50
JCC OD	no cyl.	+0.50 -0.25 X 15	no cyl.	no cyl.	no cyl.
OS	-1.50 -0.50 X 95	no cyl.	no cyl.	no cyl.	no cyl.
7cc OD	-2.25	-0.25 wc	-1.00	-1.25	-0.50
Mon+ OS	-2.25 wc	-0.50	-1.25	-1.25	-0.25
on- OD	-2.00	plano wc	-0.75	-1.00	-0.50
OS	-2.00 wc	-0.25	-1.25	-1.25	-0.25
OD	-2.25	-0.25 wc	plano	-1.75	-0.50
Bino+ OS	-2.25 wc	-0.50	plano	-1.75	-0.25
Bino- OD	-2.00	plano wc	-0.50	-1.50	-0.50
OS	-2.00 wc	-0.25	-0.50	-1.50	-0.25
7 RG OD	-1.75	+0.25 wc	+0.25	-0.50	plano
on+ OS	-2.25 wc	+0.25	+0.25	-0.75	plano
Mon- OD	-1.50	+0.50 wc	+0.25	-0.50	plano
OS	-2.00 wc	+0.50	+0.25	-0.50	plano
OD	-1.75	+0.25 wc	+0.25	-0.50	plano
Bino+ OS	-2.25 wc	+0.25	+0.25	-0.50	plano
Bino- OD	-1.50	+0.50 wc	+0.25	-0.25	+0.25
OS	-2.00 wc	+0.50	+0.25	-0.25	+0.25
#7 Mon OD	-1.25	+0.50 wc	+0.75	+1.25	+1.25
OS	-1.25 wc	+0.50	+0.75	+1.00	+1.00
Bino OD	-1.25	+0.75 wc	+0.75	+1.25	+1.25
OS	-1.25 wc	+0.75	+0.75	+1.00	+1.00
7a Bino OD	-1.50	+0.50 wc	plano	+0.25	plano
OS	-1.50 wc	+0.50	plano	plano	-0.25
P OD	-1.75	+0.25 wc	plano	-0.25	plano
OS	-1.75 wc	+0.25	plano	-0.25	plano 83.

5 HN	OD	-1.00	+1.25	+1.75	+1.25	+1.50
	OS	-1.00	+1.25	+1.75	+1.00	+1.50
LN	OD	-1.00	+1.25	+1.50	+1.00	+1.50
	OS	-1.00	+1.25	+1.50	+1.00	+1.25
14A +	OD	-1.00	+1.75	+1.50	+0.75	plano
	OS	-0.75	+1.75	+1.50	+0.75	plano
-	OD	-0.25	+2.00	+1.25	+0.50	-0.25
	OS	plano	+2.00	+1.25	+0.50	plano
14B +	OD	-0.75	+1.50	+1.75	plano	-0.25
	OS	-0.75	+1.50	+1.75	plano	plano
-	OD	-0.25	+1.75	+1.50	plano	-0.25
	OS	-0.25	+1.75	+1.50	plano	plano
RG Mon+	OD	-0.25	+1.75	+1.50	+1.00	+1.00
	OS	-0.25	+1.50	+1.50	+1.00	+1.25
Mon-	OD	plano	+2.00	+1.50	+1.00	+1.25
	OS	plano	+1.75	+1.25	+1.00	+1.00
Bino+	OD	-0.25	+1.50	+1.50	+0.75	+1.00
	OS	-0.25	+1.50	+1.75	+0.75	+0.75
Bino-	OD	-0.25	+1.75	+1.25	+0.75	+1.00
	OS	-0.25	+1.75	+1.50	+0.75	+0.75
20	OD	-6.00	-5.50	-4.25	-3.75	-5.00
	OS	-6.00	-6.25	-4.50	-3.75	-4.25
21	OD	+1.00	+2.75	+3.75	+3.25	+1.50
	OS	+1.00	+2.75	+3.50	+3.25	+1.25

SUBJECT		DF	DF	DF	RP	RP
AGE		25	25	25	24	24
EXAMINER		Keddington	Walther	O'Connell	O'Connell	Walther
#	OD	43.25/43.50 @ 90	43.25/43.50 @ 90	43.00/43.25 @ 90	41.75/42.25 @ 90	42.25/42.37@ 92
	OS	43.00/43.50 @ 90	43.00/43.87 @ 90	43.00/44.00 @ 90	42.00/42.25 @ 90	42.37/43.00@106
#4	OD	-3.75 -0.50 X180	-4.00 -0.75 X180	-4.00 -0.50 X180	+0.50	+1.00 -0.50X125
	OS	-3.75 -0.75 X180	-4.50 -0.25 X180	-4.25 -1.00 X180	+0.75 -0.75 X180	+0.50 -0.25X150
JCC	OD	-3.75 -0.25 X 35	-4.25 -0.25 X 45	-4.25 -0.25 X 35	+0.50 -0.25 X135	+0.75 -0.50X120
	OS	-3.75 -0.25 X175	-4.25 -0.50 X175	-4.25 -0.50 X175	+0.75 -0.25 X 60	+0.75 -0.50X 45
7	OD	-4.75 wc	-4.75 wc	-4.75 wc	+0.25 wc	+0.50 wc
Mon+	OS	-5.00 wc	-5.00 wc	-5.00 wc	+0.25 wc	+0.25 wc
on-	OD	-4.50 wc	-4.50 wc	-4.50 wc	+0.50 wc	+0.75 wc
	OS	-4.75 wc	-4.75 wc	-4.75 wc	+0.50 wc	+0.50 wc
	OD	-4.75 wc	-4.75 wc	-4.75 wc	+0.25 wc	+0.50 wc
Bino+	OS	-5.00 wc	-5.00 wc	-5.00 wc	+0.50 wc	+0.25 wc
Bino-	OD	-4.50 wc	-4.50 wc	-4.50 wc	+0.25 wc	+0.50 wc
	OS	-4.75 wc	-4.75 wc	-4.75 wc	+0.50 wc	+0.25 wc
7 RG	OD	-4.50 wc	-4.75 wc	-4.50 wc	+0.50 wc	+0.25 wc
on+	OS	-4.50 wc	-4.75 wc	-4.50 wc	+0.25 wc	+0.25 wc
on-	OD	-4.25 wc	-4.50 wc	-4.25 wc	+0.75 wc	+0.25 wc
	OS	-4.25 wc	-4.50 wc	-4.25 wc	+0.50 wc	+0.25 wc
	OD	-4.50 wc	-4.75 wc	-4.50 wc	+0.25 wc	+0.25 wc
Bino+	OS	-4.50 wc	-4.75 wc	-4.50 wc	+0.50 wc	+0.25 wc
Bino-	OD	-4.25 wc	-4.50 wc	-4.25 wc	+0.25 wc	+0.25 wc
	OS	-4.25 wc	-4.50 wc	-4.25 wc	+0.50 wc	+0.25 wc
#7 Mon	OD	-4.00 wc	-4.25 wc	-4.00 wc	+1.00 wc	+1.25 wc
	OS	-4.25 wc	-4.50 wc	-4.25 wc	+1.00 wc	+1.00 wc
Bino	OD	-4.00 wc	-4.00 wc	-4.00 wc	+1.00 wc	+1.25 wc
	OS	-4.25 wc	-4.25 wc	-4.25 wc	+1.00 wc	+1.00 wc
7a Bino	OD	-4.25 wc	-4.50 wc	-4.25 wc	+0.50 wc	+0.75 wc
	OS	-4.50 wc	-4.25 wc	-4.50 wc	+0.50 wc	+0.25 wc
P	OD	-4.50 wc	-4.50 wc	-4.37 wc	+0.50 wc	+0.75 wc
	OS	-4.25 wc	-4.37 wc	-4.37 wc	+0.50 wc	+0.50 wc

			DF	DF	DF	RP	RP
5	HN	OD	-2.75	-3.00	-3.00	+1.50	+1.50
		OS	-2.75	-3.25	-3.25	+1.50	+1.00
	LN	OD	-3.25	-3.00	-3.00	+1.50	+1.00
		OS	-3.25	-3.25	-3.25	+1.50	+0.50
14A	+	OD	-3.00	-3.25	-2.50	+1.25	+1.75
		OS	-3.25	-3.25	-2.75	+1.25	+1.25
	-	OD	-3.00	-3.25	-2.50	+1.75	+1.75
		OS	-3.00	-3.25	-2.75	+1.50	+1.75
14	+	OD	-3.25	-3.25	-2.75	+0.75	+1.00
		OS	-3.25	-3.25	-3.00	+1.00	+0.50
	-	OD	-3.00	-3.25	-2.75	+1.00	+1.25
		OS	-3.00	-3.25	-3.00	+1.25	+0.75
RG	Mon+	OD	-3.00	-2.75	-2.50	+2.00	+2.00
		OS	-3.25	-2.75	-2.75	+2.00	+2.00
	Mon-	OD	-2.75	-3.50	-2.25	+2.25	+2.75
		OS	-3.00	-3.25	-2.50	+2.25	+2.50
	Bino+	OD	-3.00	-3.25	-3.00	+1.75	+2.00
		OS	-2.75	-3.25	-2.75	+1.75	+2.00
	Bino-	OD	-3.25	-3.25	-3.00	+2.00	+2.25
		OS	-3.00	-3.25	-2.75	+2.00	+2.25
20		OD	-8.50	-8.50	-7.25	-5.00	-4.25
		OS	-8.75	-8.75	-7.50	-4.25	-4.25
21		OD	-1.25	-1.25	-2.00	+3.25	+3.25
		OS	-2.00	-2.00	-2.00	+3.25	+3.00

SUBJECT	KF	EH	EH	EH	MW
AGE	24	28	28	28	25
EXAMINER	Keddington	Keddington	Walther	O'Connell	Keddington
# OD	42.25/42.50 @ 95	43.37/43.87 @ 88	43.12/43.87 @ 95	43.12/43.87 @ 95	43.00/43.50@ 85
OS	42.00/42.50 @110	43.00/43.25 @ 90	42.75/43.37 @ 85	42.75/43.37 @ 85	43.25/44.50@ 85
#4 OD	+0.50 -0.50 X180	+0.25 -0.50 X 180	plano -0.50 X180	+0.25 -0.75 X180	-0.25 -0.50X 75
OS	+0.50 -0.25 X180	+0.25 -0.50 X 180	plano -0.50 X180	+0.50 -0.75 X180	-0.25 -0.25X145
JCC OD	+0.50 -0.25 X125	+0.25 -0.25 X 20	plano -0.25 X 35	plano -0.25 X 05	-0.25 -0.25X 75
OS	+0.50 -0.25 X 70	+0.25 -0.25 X 145	plano -0.25 X160	+0.25 -0.50 X155	-0.25 -0.25X133
7-[illegible] OD	+0.25 wc	-0.50 wc	-0.25 wc	-1.00 wc	-0.75 wc
Mon+ OS	+0.25 wc	-0.50 wc	+0.25 wc	-1.00 wc	-1.25 wc
[illegible]n- OD	+0.50 wc	-0.25 wc	+0.25 wc	-0.75 wc	plano wc
OS	+0.50 wc	-0.25 wc	+0.50 wc	-1.00 wc	plano wc
OD	+0.25 wc	-0.50 wc	plano wc	-1.25 wc	-1.00 wc
B[illegible]no+ OS	+0.25 wc	-0.50 wc	+0.25 wc	-1.50 wc	-1.00 wc
Bino- OD	+0.50 wc	-0.25 wc	+0.25 wc	-1.00 wc	plano wc
OS	+0.50 wc	-0.25 wc	+0.50 wc	-1.25 wc	plano wc
7 RG OD	+0.25 wc	+0.25 wc	-0.25 wc	-0.25 wc	-0.50 wc
[illegible]on+ OS	+0.25 wc	plano wc	plano wc	plano wc	-1.00 wc
[illegible]on- OD	+0.50 wc	+0.25 wc	plano wc	+0.25 wc	-0.50 wc
OS	+1.00 wc	plano wc	plano wc	+0.50 wc	-0.75 wc
OD	+0.25 wc	-0.25 wc	-0.25 wc	-0.25 wc	-0.75 wc
Bino+ OS	+0.25 wc	-0.50 wc	plano wc	plano wc	-1.00 wc
B[illegible]o- OD	+0.25 wc	plano wc	-0.25 wc	plano wc	-0.50 wc
OS	+0.25 wc	-0.25 wc	plano wc	+0.25 wc	-0.75 wc
#7 Mon OD	+0.75 wc	+0.50 wc	+0.25 wc	plano wc	+0.25 wc
OS	+0.75 wc	+0.50 wc	+0.50 wc	+0.25 wc	+0.25 wc
Bino OD	+0.75 wc	+0.50 wc	+0.50 wc	plano wc	+0.25 wc
OS	+0.75 wc	+0.50 wc	+0.75 wc	+0.25 wc	+0.25 wc
Ba[illegible]ino OD	+0.50 wc	-0.25 wc	-0.50 wc	-0.75 wc	plano wc
OS	+0.50 wc	-0.25 wc	-0.25 wc	-0.50 wc	plano wc
P OD	+0.50 wc	plano wc	-0.12 wc	-0.37 wc	-0.25 wc
OS	+0.50 wc	plano wc	+0.25 wc	-0.12 wc	-0.25 wc

		RP	EH	EH	EH	HW
5 HN	OD	+1.50	+1.00	+1.50	+1.25	+1.00
	OS	+1.50	+1.00	+1.50	+1.50	+1.00
LN	OD	+1.75	+0.50	+1.50	+1.50	+1.00
	OS	+1.75	+0.50	+1.50	+1.75	+1.00
14A +	OD	+1.50	+0.75	+1.25	+1.00	+1.00
	OS	+1.50	+1.25	+1.00	+1.25	+0.50
-	OD	+1.75	+1.00	+1.25	+1.25	+1.00
	OS	+1.75	+1.25	+1.50	+1.50	+0.75
1[illegible] +	OD	+1.00	+0.50	+1.25	+1.00	+0.50
	OS	+1.00	+0.75	+1.50	+1.25	+0.25
-	OD	+1.25	+0.75	+1.00	+1.00	+1.00
	OS	+1.25	+1.00	+1.25	+1.25	+0.75
RG Mon+	OD	+1.50	+1.00	+1.00	+0.75	+1.00
	OS	+1.75	+0.50	+0.75	+1.00	+0.50
Mon-	OD	+1.50	+1.00	+1.25	+1.00	+0.50
	OS	+1.50	+0.75	+1.25	+0.75	+1.00
Bino+	OD	+1.50	+0.75	+1.00	+0.50	plano
	OS	+1.75	+0.50	+1.00	+0.25	+0.50
ino-	OD	+1.50	+1.00	+1.00	+0.75	plano
	OS	+1.75	+0.75	+1.00	+1.00	+0.50
20	OD	-3.75	-1.75	-1.75	-1.50	-3.00
	OS	-4.50	-1.75	-1.50	-1.50	-3.25
21	OD	+3.25	+2.50	+2.25	+2.50	+2.50
	OS	+3.25	+2.50	+2.25	+2.50	+2.25

SUBJECT		MW	MW			
AGE		25	25			
EXAMINER		O'Connell	Walther			
#	OD	43.00	43.00			
	OS	43.25/44.50 @ 85	43.25/44.50 @ 85			
#4	OD	plano -0.50 X 80	-1.00 -0.25 X 90			
	OS	-0.50 -0.75 X150	-1.25 -0.50 X180			
JCC	OD	plano -0.75 X 80	-1.00 -0.75 X 85			
	OS	no cyl.	-1.25 -0.25 X150			
7[illegible]	OD	-0.75 wc	-0.75 wc			
Mon+	OS	-0.75	-1.50 wc			
[illegible]on-	OD	-0.25 wc	-0.75 wc			
	OS	-0.50	-1.00 wc			
	OD	-1.00 wc	-0.75 wc			
Bino+	OS	-1.25	-0.50 wc			
Bino-	OD	-1.25 wc	-1.00 wc			
	OS	-1.50	-0.50 wc			
7 RG	OD	-0.75 wc	-1.50 wc			
[illegible]n+	OS	-1.00	-1.75 wc			
[illegible]n-	OD	-0.75 wc	-1.25 wc			
	OS	-1.00	-1.50 wc			
	OD	-0.75 wc	-1.25 wc			
Bino+	OS	-1.00	-1.00 wc			
Bi[illegible]o-	OD	-0.50 wc	-1.50 wc			
	OS	-0.75	-1.25 wc			
7 Mon	OD	plano wc	+0.25 wc			
	OS	plano	+0.25 wc			
Bino	OD	plano wc	+0.50 wc			
	OS	plano	+0.50 wc			
[illegible]a [illegible]ino	OD	-0.25 wc	plano wc			
	OS	-0.25	plano wc			
P	OD	-0.37 wc	-0.62 wc			
	OS	-0.37	-0.50 wc			

SUBJECT		MW	MW			
#5 HN	OD	+0.50	+0.50			
	OS	+0.25	+0.50			
LN	OD	+0.25	+0.75			
	OS	plano	+0.75			
14A +	OD	+0.50	+0.50			
	OS	+0.25	+0.25			
-	OD	+1.25	plano			
	OS	+1.00	+0.25			
1[illegible] +	OD	+0.50	+0.25			
	OS	+0.25	+0.50			
-	OD	+0.50	+0.25			
	OS	plano	+0.50			
RC Mon+	OD	-0.75	plano			
	OS	-1.00	-0.75			
Mon-	OD	+1.25	-0.50			
	OS	+1.25	-0.75			
Bino+	OD	+0.25	-0.50			
	OS	+0.25	plano			
ino-	OD	-0.50	-0.75			
	OS	-0.50	-0.25			
#2(	OD	-4.50	-4.25			
	OS	-4.25	-4.50			
#21	OD	+2.50	+2.50			
	OS	+2.25	+2.25			